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March 31, 2014

Dania Zinner
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Document ID #: 3019-03312014-1

Dear Ms. Zinner:

EPA CONTRACT NUMBER EP-W-10-033
TASK ORDER NUMBER 3019
QA SUPPORT FOR THE LIBBY ASBESTOS SITE

Enclosed please find the final version (Revision 1, March 2014) of the Libby Site-wide Quality Assurance Reference Document (QARD). This report is a deliverable under Task 9 of the subject Task Order.

If you have any questions, please feel free to contact me.

Sincerely,

Timothy L. Vonnahme
Audit Group Manager, QATS Program
CB&I Federal Services, LLC
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cc: Shari Myer, EPA-ASB QATS Project Officer
Administrative Contracting Officer (Letter only)
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-Final -
Site-wide Quality Assurance Reference Document for the Libby Asbestos Superfund Site Libby, Montana

Revision 1 – March 2014

Revision Updated by:

The Data Auditing Group
Quality Assurance Technical Support Program
CB&I Federal Services, LLC
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QATS Contract Number: EP-W-10-033

Prepared for:

Dania Zinner

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Through:

Shari Myer

Analytical Services Branch
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OFFICE OF SUPERFUND REMEDIATION AND TECHNOLOGY INNOVATION
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Site-Wide Quality Assurance Reference Document for the Libby Asbestos Superfund Site Libby, Montana

Revision 1 – March 2014

REVISION LOG:

Revision No.	Revision Date	Revision Description
0	05/04/2012	NA
1	03/21/2014	Annual update to reflect changes to referenced SOPs, addition of newly developed SOPs, references to recently developed laboratory modifications, changes to organizational structure and personnel, and changes to reporting requirements.

APPROVALS:

Signature: _____ Date: 3/31/2014
Michael Lenkauskas, Consultant, CB & I Federal Services, LLC

Signature: Timothy Vonnahme Date: 3/31/2014
Timothy Vonnahme, Audit Manager, CB & I Federal Services, LLC

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Dania Zinner, EPA Region 8, QATS Task Order Manager

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Acronyms

AIHA	American Industrial Hygiene Association
AHERA	Asbestos Hazard Emergency Response Act
AOC	Administrative Order on Consent
ASTM	American Society of Testing and Materials
BNSF	Burlington Northern and Santa Fe Railroad
CARB	California Air Resources Board
CB&I	CB&I Federal Services, LLC
CDM Smith	CDM Federal Programs Corporation
CFR	Code of Federal Regulations
COC	Chain-of-custody
cm	Centimeter
cm^{-2}	1/square centimeters
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EDS	Energy Dispersive Spectrometry
EMSL	EMSL Analytical, Inc.
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ERS	Environmental Resource Specialist
ESAT	Environmental Services Assistance Team
f	Factor
FBAS	Fluidized Bed Asbestos Segregator
FSDS	Field Sample Data Sheet
FTL	Field Team Leader
g	Grams
GIS	Geographic Information System
GPI	General Property Investigation
GPS	Global Positioning System
W.R. Grace	W.R. Grace and Company
H&S	Health and Safety
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HDPE	High-density Polyethylene
HEPA	High-efficiency Particulate Air
Hygeia	Hygeia Laboratories, Inc.
ID	Identification
IEC	International Electro-technical Commission
IDW	Investigation-derived Waste
IHLAP	Industrial Hygiene Laboratory Accreditation Program
ISO	International Organization for Standardization
KDC	Kootenai Development Corporation
LA	Libby Amphibole
LADT	Libby Asbestos Data Tool
LB	Laboratory Blank
LC	Laboratory Coordinator
LIMS	Laboratory Information Management System

Acronyms (cont.)

MDEQ	Montana Department of Environmental Quality
mm	Millimeter
mm^{-2}	1/square millimeters
ND	Non-detect
NFG	National Functional Guidelines
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAT	Proficiency Analytical Testing
PCM	Phase Contrast Microscopy
PE	Performance Evaluation
PLM-VE	Polarized Light Microscopy-Visual Estimation
PM	Project Manager
PPE	Personal Protective Equipment
PRI-ER	Project Resources, Inc. – Environmental Restoration
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QATS	Quality Assurance Technical Support
QA/QC	Quality Assurance/Quality Control
RI/FS	Remedial Investigation/Feasibility Study
ROM	Record of Modification
RPM	Remedial Project Manager
SAED	Selected Area Electron Diffraction
SAP	Sampling and Analysis Plan
s/cc	Structures per Cubic Centimeter
s/cm^2	Structures per Square Centimeter
s/g	Structures per Gram
s/mm^2	Structures per Square Millimeter
Site	Libby Asbestos Superfund Site
SOP	Standard Operating Procedure
SPF	Sample Preparation Facility
SQL	Structured Query Language
SRM	Standard Reference Materials
QARD	Quality Assurance Reference Document
TAU	Technical Assistance Unit
TEM	Transmission Electron Microscopy
TM	Task Manager
TOAD	Troy Owner Access Database
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
µm	Micrometer (1 µm = 0.000001 meters)
%	Percent
±	Plus or Minus

Section 1 Introduction

This section provides an introduction to the Libby Asbestos Superfund Site (Site) and summarizes the purpose and organization of this document.

1.1 Site Description

The Site is centered within and around the community of Libby, Montana, located within Sections 3 and 10, Township 30 North, Range 31 West of the Libby Quadrangle in Lincoln County, Montana. The City of Libby is located 7 miles southwest of a former vermiculite mine that operated from the 1920s until 1990. Vermiculite from this mine contains varying levels of a form of asbestos referred to as Libby amphibole (LA). Exposure to LA has been shown to cause a range of adverse health effects in people, including not only workers at the mine and processing facilities, but also in residents of Libby. Since 1999, the U.S. Environmental Protection Agency (EPA) has conducted sampling and cleanup activities to address asbestos-contaminated areas at the Site. The Site was listed on the Superfund National Priorities List (NPL) in October 2002.

The Site includes homes and businesses that may have become contaminated with asbestos as a result of the vermiculite mining and processing conducted in and around Libby, as well as other areas in the vicinity that may have been affected by mining-related releases of asbestos. For long-term management purposes, the Site has been divided into eight operable units (OUs) (see **Appendix A** for maps showing the boundary of each OU):

- OU1, Former Export Plant – This OU is defined geographically by the property boundary of the parcel of land that included the former export plant and nearby impacted areas.

- OU2, Former Screening Plant – This OU includes areas impacted by contamination released from the former W.R. Grace and Company (W.R. Grace) screening plant. These areas include the former screening plant, the adjacent Flyway property, the Highway 37 right-of-way adjacent to the former screening plant and Rainy Creek Road, and privately-owned property. The Kootenai Bluff Subdivision area (the former W.R. Grace railroad loading station area), located directly across the Kootenai River from the former screening plant, has been removed from OU2 and is now part of OU4.

- OU3, Libby Vermiculite Mine – The mine OU includes the former vermiculite mine and the geographic area (including the ponds and streams and forested area) surrounding the former vermiculite mine that has been affected by releases from the mine. The Kootenai River and Rainy Creek Road are also included in OU3.

- OU4, Main Residential/Commercial Area – OU4 is defined as residential, commercial, industrial (not associated with mining operations), and public properties, including schools and parks in and around the City of Libby, or those that have received material from the mine.

- OU5, Former Stimson Lumber Mill – This OU is defined geographically by the parcel of land that included the former Stimson Lumber Company. OU5 is bounded by the high

bank of Libby Creek to the east, the Kootenai River to the north, and residential/commercial/industrial property within OU4 to the south and west. This OU is approximately 400 acres in size and is currently occupied by various vacant structures/buildings as well as multiple operating businesses (lumber processing, log storage, excavation contractor, etc.). Within the OU5 boundary is the Libby Groundwater Superfund Site, which is not associated with the Libby Asbestos Superfund Site.

- OU6, Burlington Northern and Santa Fe Railroad – This OU is owned and operated by the Burlington Northern and Santa Fe Railroad (BNSF), and is defined geographically by the BNSF property boundaries from the eastern boundary of OU4 to the western boundary of OU7 and extent of contamination associated with the rail yard.

- OU7, Town of Troy – This OU includes all residential, commercial, and public properties in and around the Town of Troy, located 20 miles west of downtown Libby.

- OU8, Roadways – This OU is comprised of the United States and Montana State Highway rights-of-way within the OU4 and OU7 boundaries.

1.2 Document Purpose

This document serves as the *Site-wide Quality Assurance Reference Document* (QARD) for all field, laboratory, and data management activities in support of sample collection and investigation activities at the Site. This QARD is applicable to all OUs. However, activities at OU3 (the mine) may differ in some instances from other OUs because the management entities and contractors are different. This QARD will identify when and how specified procedures differ for OU3.

The original version (Revision 0) of this QARD was prepared by CDM Federal Programs Corporation (CDM Smith), the Site contractor with primary responsibility for field sampling and Site investigations in most OUs, with oversight by and input from the EPA. Revision 1 updates to this document were made by CB&I Federal Services, LLC (CB&I), the EPA's Quality Assurance Technical Support (QATS) contractor, with oversight and input from the EPA. The purpose of this document is to provide a comprehensive summary of the general sampling and laboratory protocols; descriptions of standard field processes, such as field logbook documentation, sample custody, chain-of-custody (COC) generation, and sample shipment; descriptions of laboratory methods and procedures; descriptions of data management procedures; and the quality assurance/quality control (QA/QC) procedures for each.

Sampling program specifics, such as study designs, data quality objectives (DQOs), quality assurance procedures, and analytical requirements, will be detailed in unique sampling and analysis plans (SAPs) and quality assurance project plans (QAPPs), which are prepared prior to each new investigation, hereafter referred to as "investigation-specific QAPPs."

This QARD is to serve as a reference document that can be utilized in the development of the investigation-specific QAPPs. This document may not be cited in the investigation-specific QAPPs. In addition, the investigation-specific QAPPs may modify the QA/QC procedures as appropriate to support the investigation-specific goals. Any such modifications must be well-defined and approved by the project management team prior to implementation.

Information collected during the implementation of the QA/QC procedures will be used to evaluate the potential influence of field, sample preparation, laboratory, and database processes on data quality, and to determine if required changes are necessary to improve the level of data quality for samples collected, processed (if applicable), and analyzed during investigation activities. This QARD will be updated as processes are modified and refined at the Site. A complete up-to-date copy of the QARD will be maintained in the Libby eRooms[a]. The document recipient is responsible for maintaining this QARD in an up-to-date condition and ensuring that the document is readily available for reference. This QARD will be reviewed, revised, and reissued as directed by the EPA.

1.3 Document Organization

This QARD is organized as follows:

Section 1 – Introduction

Section 2 – Project Roles and Responsibilities

Section 3 – Field Sampling Methods and Requirements

Section 4 – Analytical Laboratory Methods and Requirements

Section 5 – Troy Sample Preparation Facility Methods and Requirements

Section 6 – Data Management Procedures and Requirements

Section 7 – References

All referenced tables and figures follow the document text. All cited appendices are provided as electronic attachments to this document.

[a] See **Appendix B** for a summary of the different types of electronic repositories utilized to manage governing documents at the Site.

Section 2 Project Roles and Responsibilities

This section describes the project roles and responsibilities for the federal and state agencies and contractors that are part of the Site team as they relate to field sampling and Site investigation activities. **Figure 2-1** presents the organizational chart for the Site team and illustrates the lines of authority and communication between the agencies and contractors for OU1, OU2, OU4, OU5, OU6, OU7, and OU8. This organizational chart is also applicable to construction activities in these OUs. As noted previously, the management entities and contractors are different for OU3.

For OU3, the EPA has entered into an Administrative Order on Consent (AOC) with Respondents W.R. Grace and Kootenai Development Corporation (KDC) for the completion of the remedial investigation/feasibility study (RI/FS). Under the terms of the AOC, the EPA is responsible for developing the plans that govern investigations conducted at OU3, but W.R. Grace and KDC are responsible for implementing the field collection efforts associated with these investigations. Analytical services are provided by laboratories under contract with ESAT, with the costs for these services recovered through Remedium Group, Inc (Remedium), the designated Project Coordinator for Respondents W.R. Grace and KDC. **Figure 2-2** presents the organizational chart for the OU3 team and illustrates the lines of authority and communication between the agencies and contractors.

Note: There are two distinct instances for OU3 where the roles/responsibilities differ from what is described above. For OU3, the EPA is responsible for samples collected as part of health and safety (H&S) monitoring for workers driving on Rainy Creek Road and water samples collected from the Kootenai River as part of cleanup activities performed outside of OU3. W.R. Grace is responsible for H&S monitoring and sample collection as part of removal activities conducted in OU3.

The investigation-specific QAPPs will provide an organizational chart that identifies the roles and responsibilities of each agency and contractor involved in the investigation, including names of individuals for each role.

2.1 U.S. Environmental Protection Agency

The EPA Region 8 is the lead agency for most OUs at the Site and has the overall responsibility of planning and implementing investigation actions at the Site. The EPA project management team consists of the project team leader, remedial project managers (RPMs), and the Technical Assistance Unit (TAU). The EPA project management team is supported by the Environmental Response Team (ERT), the Environmental Services Assistance Team (ESAT), the Quality Assurance Technical Support (QATS) program, and their contractors.

2.1.1 Project Team Leader

The EPA project team leader for the Site is Rebecca Thomas. Ms. Thomas is responsible for determining the overall project direction and scope, and is assisted by other EPA team management personnel who are assigned specific areas of responsibility.

2.1.2 Remedial Project Managers

Due to the size of the project, several EPA RPMs assist the EPA project team leader with Site management. An EPA RPM is assigned to each OU and is responsible for the following:

- Completing an RI/FS for the OU
- Determining data gaps that need to be filled through the RI/FS process
- Determining the scope of work for investigation activities needed to fill identified data gaps
- Completing of a record of decision for the OU

Dania Zinner is the RPM assigned to the former processing areas (OU1, OU2), the former Stimson Lumber Mill site (OU5), the railroad corridors (OU6), and transportation corridors and roadways (OU8). Christina Progess is the RPM assigned to the mine area (OU3). Elizabeth Fagan is the RPM assigned to the residential/commercial areas of Libby and Troy (OU4, OU7).

Mike Cirian is the onsite RPM located in Libby. The onsite RPM is responsible for all site Environmental Resource Specialist (ERS) Program and construction activities, including providing updates to the community on progress made from all investigations, particularly as they relate to emergency response actions.

Stanley Christensen is the remedial unit chief for the EPA Region 8 Superfund program and is responsible for the oversight of all the Libby RPMs.

In addition, because of the quantity and complexity of the data collected at the Site, the EPA has also designated a Libby Data Manager, Jeffrey Mosal to manage and oversee the various data support contractors (see Sections 2.1.5 and 2.1.6).

2.1.3 Quality Assurance Manager

There is no individual designated as the EPA Quality Assurance Manager for the Libby project. Rather, the Region 8 quality assurance (QA) program has delegated authority to the EPA RPMs. This means that RPMs have the ability to review and approve governing investigation documents developed by Site contractors. Thus, it is the responsibility of the RPMs to ensure that Site documents are prepared in accordance with the EPA QA guidelines and requirements. They are also responsible for managing and overseeing all aspects of the QA/QC program for their respective OUs. In this regard, the RPMs are supported via the QATS contract (see Section 2.1.7).

2.1.4 Technical Assistance Unit

The EPA TAU assists the EPA RPMs in determining overall DQOs for each investigation, determining data gaps to complete risk assessment activities, and reviewing all documents related to investigation activities and data reporting. Deborah McKean (EPA Region 8) is the TAU chief for the Superfund Program. She is supported by a team of EPA scientists, toxicologists, and risk assessors.

2.1.5 Environmental Response Team

The EPA ERT is responsible for the administration of all Scribe data management aspects of this project. See Section 6.1.4 for additional information on Scribe. Joseph Schafer is responsible for overseeing the ERT data management support contract. ERT is responsible for the development and management of Scribe and the project-specific data reporting requirements for the Libby project.

2.1.6 Environmental Services Assistance Team

The EPA ESAT is responsible for procuring analytical and preparation laboratory services and providing direction to the laboratories for all investigation-related support activities for most OUs[b]. In EPA Region 8, the ESAT support contractor is TechLaw, Inc. Don Goodrich (EPA Region 8) is responsible for managing the ESAT laboratory support contract for asbestos. The ESAT Region 8 Team Manager at TechLaw, Inc. is Mark McDaniel. He is also the designated laboratory coordinator (LC) for the Libby project. The LC (or their designate) is responsible for the following:

- Procuring laboratories
- Communicating with the EPA regarding budgets related to sample analysis
- Ensuring that project analysis needs can be met by subcontracted laboratories
- Tracking and prioritizing samples through the analysis process to ensure results are provided within the appropriate turn-around time
- Maintaining coordination with project laboratories through regularly scheduled conference calls
- Tracking and managing modifications to laboratory procedures and ensuring laboratory modifications are communicated to all project laboratories
- Identifying and relaying technical issues related to sample analysis and results reporting
- Relaying any laboratory QA/QC issues to the QATS contractor

ESAT is also responsible for managing and maintaining the Laboratory Analytical Data Tool LADT, used to report PLM analyses for ESAT, and uploading new analytical results to the Scribe project database for most OUs[c]. The ESAT project data manager for the Site is Janelle Lohman (TechLaw, Inc.).

TechLaw, Inc. has contracted with Weston Solutions, Inc. (Weston) to provide additional data management support for the Site. Weston is responsible for the development and maintenance of Response Manager.

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[b] For OU3, laboratory procurement and management is performed by Remedium Group, Inc. Thus, the LC for OU3 is Remedium Group, Inc.

[c] For OU3, data management responsibilities are performed by CDM Smith (see Section 6.2).

2.1.7 Quality Assurance Technical Support

The QATS contract provides QA support to the EPA Superfund Program through the Analytical Services Branch. Dania Zinner (EPA Region 8) is responsible for managing the Libby support task under the QATS contract. The QATS support contractor is CB&I Federal Services, LLC (CB&I). Michael Lenkauskas, a contractor with CB&I is the primary point of contact at CB&I's QATS program. The QATS contractor is responsible for:

- Performing on-site analytical laboratory and preparation facility audits
- Developing and reviewing laboratory modifications , standard operating procedures (SOPs), and quality control (QC) procedures
- Participating in the Libby-specific laboratory mentoring program
- Maintaining coordination with project laboratories through regularly scheduled conference calls
- Supporting annual data validation efforts
- Tracking and evaluating field, preparation facility, and laboratory QC programs
- Supporting the LC in tracking and managing modifications to laboratory procedures
- Reviewing laboratory performance evaluation (PE) results
- Selecting inter-laboratory samples and reviewing inter-laboratory results

In addition, it is the responsibility of the QATS contractor or their designate to review, revise, and re-issue this QARD as determined by the EPA.

2.2 U.S. Army Corps of Engineers

With the exception of OU3, the Site is managed by the EPA with field execution and site management of some activities (i.e., general property investigation [GPI], sample management, community involvement coordination [CIC], removal-related work) conducted through an Interagency Agreement with the U.S. Army Corps of Engineers (USACE) Rapid Response Program. The USACE program manager is Mary Darling. The USACE removal contractor for the Site is Project Resources, Inc.-Environmental Restoration (PRI-ER). Because the removal contractor is not responsible for sample collection as part of investigation-specific QAPPs, the QA/QC procedures described in this QARD are not applicable to PRI-ER. The USACE architect and engineering contractor for the Site is CDM Smith.

2.3 Field Support Contractors

There are several field contractors at the Site that are responsible for the planning and implementation of field sampling and Site investigations.

CDM Smith provides support to the Site under various contracting agreements with the EPA and the USACE. CDM Smith is the Site field contractor with the primary responsibility for planning and implementing field sampling and Site investigations in most OUs, including OU1, OU2, OU4, OU5, OU6, and OU7. CDM Smith is responsible for providing support for the Environmental Resource Specialists (ERS) program for Libby, which includes coordinating with Montana One Call (U-Dig) on requests for Libby, providing information to and educating residents and business owners about the Libby project, and coordinating the implementation of response actions. CDM Smith also provides Libby EPA Information Center support, risk assessment support, advises ESAT/ERT on data management, provides general laboratory support, provides support to the EPA in the development of sampling plans and providing data management support for OU3, and advises ESAT on data management procedures

For OU3, several field contractors have been utilized by W. R. Grace through their wholly owned subsidiary, Remedium, to implement field sampling activities at OU3. These contractors include Golder Associates and MWH Americas, as well as their subcontractors, Chapman Construction and Anchor QEA. Field oversight of OU3 sampling activities is conducted by EPA's oversight contractor HDR Engineering, Inc.

The following sections describe the principle roles and responsibilities of key field contractor managers and personnel as they relate to field sampling and Site investigation activities. (Note: Each field contractor may have different titles that are utilized to describe the various managers and personnel positions that support Site investigations. The following sections seek to describe the basic roles and responsibilities that should be part of any investigation-specific QAPP.)

2.3.1 Project Manager

The project manager (PM) is responsible for the overall management and coordination of the following activities for the Site:

- Maintaining frequent communication with the client (i.e., EPA, MDEQ, USACE) regarding the overall status of the project
- Preparing client status reports
- Tracking overall budgets and schedules
- Supervising production and review of deliverables
- If applicable, notifying the client of significant problems affecting the quality of data or the ability to meet project objectives
- Incorporating and informing the client(s) of changes in the work plans, SAPs, QAPPs, health and safety plans (HASPs), and other project documents

2.3.2 Task Manager

In some cases, multiple tasks may be associated with a given project. In order to facilitate project management, a PM may assign different managers to specific tasks and/or investigations. A task manager (TM) is responsible for the following:

- Managing the task and investigation-specific budgets
- Maintaining communication with the PM regarding the status of all investigations, issues that could impact any investigations (e.g., scope, schedule, budget), and any situations that require deviations from investigation-specific guidance documents
- Ensuring investigation activities are implemented by assigned field team leaders (FTLs)

2.3.3 Field Team Leader

For many investigations, the PM or TM will assign an FTL. The FTL is responsible for the management and coordination of the following activities:

- Organizing and conducting daily meetings with field personnel
- Coordinating daily work activities for field personnel
- Scheduling personnel and material resources needed to complete investigation activities
- If necessary, identifying problems and resolving difficulties in consultation with the client and contractor staff
- Ensuring field aspects of all investigations, including this QARD and other project governing documents, are implemented by the field personnel
- Implementing and documenting corrective action procedures at the field team level
- If applicable, notifying the responsible QA staff immediately of significant field problems affecting the quality of data or the ability to meet project objectives
- Providing communication between the sampling teams and project management

2.3.4 Field Quality Assurance Manager

The field quality assurance manager (QAM) is responsible for the following investigation activities:

- Reviewing and approving project-specific documents
- Maintaining awareness of project activities and their QA/QC requirements
- Consulting with QA staff, as needed, on appropriate QA/QC measures and corrective actions

- Conducting audits, surveillances, or assessments to check on the use of appropriate QA/QC measures and project requirement implementation
- Identifying QA areas that need changes or improvements
- Verifying that corrective actions resulting from assessments, field surveillances, and/or field audits are documented and implemented
- Tracking and maintaining records to document field modifications
- Communicating directly with the PM or TM regarding QA/QC issues

2.3.5 Health and Safety Manager

The field health and safety (H&S) manager is responsible for the following:

- Developing and updating the field HASP and ensuring all field staff are informed of any revisions
- Ensuring that the protocols specified in the HASP are carried out during field activities
- Ensuring that up-to-date copies of the HASP and relevant H&S manuals are available at the Site at all times
- Based on existing conditions, upgrading or downgrading levels of personal protective equipment (PPE) in accordance with the HASP
- Conducting an initial H&S meeting/orientation for all field personnel
- Providing an overview of the HASP to all assigned field personnel and having them sign a form to indicate they understand the content of the HASP document and will adhere to its specifications
- Resolving any H&S questions or issues identified by field personnel that arise during field activities

2.3.6 Field Team Staff

Field team staff is responsible for the correct implementation of each investigation, including the following under the supervision of the investigation-specific FTLs:

- Using proper inspection and/or sampling techniques
- Maintaining proper sample custody, if providing sampling support
- Documenting daily field activities by using the appropriate field forms and/or logbooks
- Documenting deviations in field procedures to governing documents

- Maintaining appropriate levels of QA/QC as described by processes and procedures detailed in the investigation-specific QAPPs

2.3.7 Sample Coordination Staff

The sample coordination staff consists of the field sample coordinator, the field data manager, and their support staff. The field sample coordinator and their support staff are responsible for the following, with support from the administrative staff:

- Maintaining all investigation related paperwork generated at the field level
- Communicating with the LC regarding the estimated number of samples and expected analytical turn-around times
- Shipping samples, as designated by the LC
- Ensuring all samples are maintained with proper COC requirements
- Preparing COCs for intra-laboratory samples via coordination with the LC

The field data manager and their staff are responsible for:

- Managing the data entry of sample information
- Updating and maintaining the local field project database(s)
- Coordinating with the LC and project data manager regarding corrections to sample documentation

2.3.8 Community Involvement Staff

Community involvement staff assists the field team and project management when investigation activities are conducted at residential and commercial properties. The community involvement staff discusses the investigation-specific QAPPs with residents and property owners by explaining what work will be conducted at their properties and answering any questions residents may have. When a resident is required to be relocated, the community involvement staff assists them through the relocation processes used at the Site.

2.3.9 Administrative Support Staff

Administrative support staff is responsible for project procurement support, document maintenance and general office support activities. Related to investigation activities, the administrative support staff is responsible for filing and maintaining all documents collected in the field, and often supports community involvement staff in contacting residents to schedule investigation activities.

2.3.10 Technical Support Staff

Technical support staff is responsible for the development of investigation-specific DQOs, sampling memoranda, SAPs, and QAPPs. The technical support staff is also responsible for the review and interpretation of resulting data from these investigations, as well as the preparation of requested reports (e.g., investigation-specific data summary reports, remedial investigation reports, human health risk assessments, etc.) for the Site.

2.4 Laboratory Support Contractors

There are several laboratory contractors that are responsible for the preparation and analysis of samples collected as part of field sampling and Site investigations.

The following commercial analytical laboratories provide asbestos analysis support to the Site OUs under subcontracting agreements with ESAT:

- EMSL Analytical, Inc. (EMSL) with laboratories in Libby, Montana; Cinnaminson, New Jersey; Denver, Colorado; and New York, New York
- Hygeia Laboratories, Inc. (Hygeia) in Sierra Madre, California
- Reservoirs Environmental Services, Inc. (RESI) in Denver, Colorado

In addition to these commercial laboratories, ESAT also manages the EPA Region 8 Laboratory in Golden, Colorado and the Sample Preparation Facility (SPF) in Troy, Montana.

For OU3, samples collected as part of field sampling and Site investigations are analyzed for asbestos by EMSL through its contract with ESAT, with costs recovered from Remedium.

The following sections describe the principle roles and responsibilities of key laboratory managers and personnel as they relate to field sampling and Site investigation activities. [Note: Each laboratory may have different titles that are utilized to describe the various managers and personnel positions that support Site investigations. The following sections seek to describe the basic laboratory roles and responsibilities.]

2.4.1 Laboratory Manager

The laboratory manager is responsible for the overall management and coordination of the following activities for the Site:

- Communicating with the LC on laboratory capacity, sample priority, and analytical requirements
- Coordinating with the LC regarding corrections to analysis or results documentation
- Participating in regularly scheduled conference calls with the project laboratories
- Ensuring all samples are maintained within proper COC requirements

- Ensuring proper documentation of sample preparation and analysis activities in the appropriate bench sheets and/or logbooks

  Relaying any laboratory QA/QC issues to the LC and QATS contractor

2.4.2 Laboratory Quality Assurance Manager

The laboratory QAM is responsible for the following activities:

- Maintaining awareness of project laboratory support activities and their QA/QC requirements
- Consulting with laboratory support staff, as needed, on appropriate QA/QC measures and corrective actions
- Conducting internal laboratory audits to check on the use of appropriate QA/QC measures and project requirement implementation
- Identifying QA areas that need changes or improvements
- Verifying that corrective actions resulting from laboratory audits are documented and implemented
- Documenting deviations in preparation or analytical procedures to governing documents
- Communicating directly with the laboratory manager regarding QA/QC issues

2.4.3 Laboratory Support Staff

The laboratory support staff is responsible for the correct implementation of the appropriate preparation and analysis procedures, including the following under the supervision of the laboratory manager:

- Using proper preparation and analysis techniques, as specified in the investigation-specific QAPPs
- Maintaining proper sample custody
- Documenting daily preparation and analysis activities by using the appropriate bench sheets and/or logbooks
- Maintaining appropriate levels of QA/QC as described by processes and procedures detailed in the investigation-specific QAPPs

2.5 Other Technical Support Contractors

Other contractors providing technical support to the EPA at the Site include:

- SRC, Inc. is tasked with providing general technical support for the purposes of supporting human health and ecological risk assessment evaluations at the Site.
- HDR Engineering, Inc. (HDR) is tasked with providing field oversight for OU3, and the development of documents for OU3, OU5, and OU8.

These technical contractors are not responsible for field sample collection as part of investigation-specific QAPPs.

Section 3 Field Sampling Methods and Requirements

The field sampling processes and procedures used in support of field investigation activities at the Site are discussed in this section, along with their related QA/QC procedures.

3.1 Sample Collection Procedures

This section summarizes the SOPs used in the sample collection of environmental media at the Site. The types of QC samples collected for each media to ensure data quality is achieved are also discussed in this section.

The most recent versions of all referenced sampling SOPs are available in the Libby Field eRoom (see **Appendix B**). These sampling procedures are intended to summarize the basic requirements for sample collection for each type of media. *The investigation-specific QAPPs should clearly identify any deviations from the procedures as described below, as well as any specific field sampling methods and requirements that are not detailed in this section.*

3.1.1 Air Sampling

3.1.1.1 Collection Procedures

Sampling air for the presence of asbestos is accomplished by using a pump to draw a known volume of air through a filter inside a sampling cassette, which traps all of the solid particles in the air onto the filter surface. This filter is then examined for asbestos. There are two types of air samples collected in support of investigation activities: personal and stationary. In personal air monitoring, the air sampling cassette is worn by an individual as they engage in various activities and monitors the air in the breathing zone of the individual. In stationary air monitoring, the air sampling cassette is fixed at a specific location (e.g., on a telescoping stand).

The following SOP specifies the procedural requirements for the collection of air samples for investigation activities at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

- EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air* – This is a Site-specific SOP derived from SOP EPA-LIBBY-01 and SOP CDM-LIBBY-14 that provides a standardized method for sampling air to measure asbestos air concentrations by drawing a known volume of air though a sampling filter. The SOP is applicable to any type of asbestos fiber that may exist in air and is applicable to both personal and stationary air sampling techniques. Filters collected by the procedures described in this SOP are suitable for analysis by transmission electron microscopy (TEM), phase contrast microscopy (PCM), and scanning electron microscopy (SEM).

3.1.1.2 Sampling Equipment

The following is a basic list of equipment needed for air sample collection (see Section 3.2.4 for a list of general sampling equipment):

- Sampling pump - Selection of the appropriate sampling pump(s) is based on the sample type, flow rate, and sample collection duration. *The investigation-specific QAPPs will specify the target flow rate and sample collection duration.* All sampling pumps used for the collection of air samples must be capable of providing a non-fluctuating air-flow through the sampling media, and maintaining the initial volume flow rate to within plus or minus (±) 10 percent (%) throughout the sampling period.

- Sample cassettes – *Unless otherwise stated in the investigation-specific QAPP,* a commercially available 25-millimeter (mm), three-piece cassette with a 50-mm electronically conductive extension cowl loaded with a 0.8 micrometer (µm) pore size mixed cellulose ester (MCE) filter will be used.

- Telescoping stands – Telescoping stands designed specifically to hold stationary sample cassettes at the desired height are used to support the sample cassette.

- Inert tubing - Tygon® tubing with a 3/16-inch inner diameter and 5/16-inch outer diameter is used in the sample collection train to connect the outflow end of the sample cassette to the sampling pump.

- Rotameter – A rotameter is used as the secondary calibration standard and is able to measure flow rates to ± 5% accuracy at the investigation required flow rates.

3.1.1.3 Equipment Calibration

Each air sampling pump is calibrated to the desired flow rate, as described in SOP EPA-LIBBY-2012-10. Rotameters are the secondary calibration standard used at the Site for day-to-day calibrations. At a minimum, sampling pumps are calibrated with a rotameter by a field team member before and after each sampling event. Field calibration records are maintained in the field logbook.

Rotameters are calibrated to a primary calibration standard on a quarterly basis by the H&S manager (or their designate), as described in SOP EPA-LIBBY-2012-10. Quarterly calibration records are maintained in the appropriate field office in the project files. The type of primary calibration standard used at the Site may differ depending upon the field contractor (e.g., CDM Smith utilizes a DryCal® DC-Lite flow meter manufactured by Bios International Corporation). *The investigation-specific QAPPs should identify the appropriate primary calibration standard that will be used to calibrate the rotameters.*

To prevent potential cross-contamination, each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. The cap used at the end of the rotameter tubing will be replaced each morning after it is used.

3.1.1.4 Flow Rate Verification

The investigation-specific QAPPs will specify the required flow rate verification frequency. At a minimum, the flow rate will be checked at the midpoint of the sample collection period. Flow rate verifications can also be implemented on a more frequent basis, as needed, if flow rate maintenance becomes an issue. A flow rate check should be performed anytime the sampling pump is moved.

At each flow rate verification check, if the flow rate is outside the acceptable limit, the rate will be adjusted back to the target flow rate. Adjustment of flow rates during flow rate verifications will be performed as described in SOP EPA-LIBBY-2012-10. *The investigation-specific QAPPs will specify the acceptable limits for increased/decreased flow rates, as well as appropriate procedures for what to do if the achieved flow rates are outside acceptable limits or if there is a pump fault during sample collection.*

3.1.1.5 Total Air Sample Volume Calculation

The field teams utilize a sample volume calculation tool (see Section 6.1.1.1 for details on this tool) to compute the total sample volume from the start and stop flow rates and the start and stop times recorded on the field sample data sheet (FSDS). See Section 3.2.6 for more information on completion of FSDS forms. In this tool, the average of the start and stop flow rates is used to calculate the sample volume during each check interval. The calculated sample volumes for each check interval are then added together to compute the total air sample volume collected as follows:

$$V_{total} = \sum \text{Duration}_i \cdot \text{Flow Rate}_i$$

where:

V_{total} = total air sample volume (liters)

Duration_i = sample duration for interval 'i' (minutes)

Flow Rate_i = average flow rate for interval 'i' (liters/minute)

This flow rate calculation is checked as part of the data verification process (see Section 6.3).

3.1.1.6 Field QC Samples

The four types of field QC samples submitted in association with asbestos air sample collection are lot blanks, field blanks, co-located samples, and drying blanks. Each type of field QC sample is described in detail below. **Table 3-1** summarizes the collection frequency rates and acceptance criteria for each type of field QC sample. *The investigation-specific QAPPs should specify the applicable collection frequencies and acceptance criteria for field QC samples for air.*

Lot blanks – Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. A lot blank is a randomly selected filter cassette from a manufactured lot. Cassette lot blanks from each lot will be submitted for analysis at a frequency of 1 lot blank per 500 cassettes. It is the responsibility of the FTL to submit the appropriate number of lot blanks prior to cassette use in the field. The lot blanks are analyzed for asbestos by the same method used for field sample analysis. *The investigation-specific QAPPs will specify the analysis requirements (i.e., the number of grid openings that should be analyzed) for lot blanks.* Lot blank results are reviewed by the FTL before any cassette in the lot is used for sample collection. The entire batch of cassettes is rejected if any asbestos is detected on the lot blank. Only filter lots with acceptable lot blank results are placed in the general supply area for use by project personnel.

Field blanks – Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. The collection frequency for field blanks will be one per field team per day. It is the responsibility of each field team to collect the appropriate number of field blanks. Field blanks are collected by removing the end cap of the sample cassette to expose the filter in the same area where sample collection occurs for about 30 seconds before re-capping the sample cassette. One field blank per week, chosen at random by the sample coordinator, is analyzed for each investigation. The field blanks are analyzed for asbestos by the same method that is used for field sample analysis. *The investigation-specific QAPPs will specify the analysis requirements (i.e., the number of grid openings that should be analyzed) for field blanks.*

If asbestos is observed on the analyzed field blank, all other field blanks collected by that team during that week will be submitted for analysis to determine the potential impact on the related sample results. It is expected, based on historical analysis of the rate of asbestos detection in field blanks (CDM Smith 2011), that asbestos will only be observed on field blanks on very rare occasions. If any asbestos is observed on a field blank, the FTL and/or laboratory manager will be notified and will take appropriate measures (e.g., re-training on sample collection and analysis procedures) to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.)

Co-located samples – Co-located field samples are used to evaluate the inherent variability of sample results due to small-scale variability in concentration as well as measurement error in sample analysis. Co-located samples are collected by placing two identical samplers next to each other and, either air is drawn from one source and split with a manifold (a field split), or two pumps are adjacent to each other and each collects a sample at the specified sample flow rate (a field duplicate). Co-located samples can be personal air monitoring samples (e.g., one individual wearing two pumps) or stationary air monitoring samples (e.g., two separate pumps at a specified sampling location). Each co-located sample is given a unique sample number and field personnel record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location identification (ID) is assigned to the co-located sample as the parent field sample. See Section 3.2.6 for more information on completion of FSDS forms. Co-located samples will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between parent field samples and co-located samples).

The frequency of collection and analysis for co-located samples is 5% (1 in 20) or one per sampling event (whichever is higher). It is the responsibility of the FTL to ensure that the appropriate number of co-located field samples is collected. Results from co-located samples will be compared using the Poisson ratio test using a 90% confidence interval (Nelson 1982). Because co-located samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of co-located samples. Rather, results are used to determine the magnitude of this variability to evaluate data usability. In general, if more than 20% of all co-located samples for an investigation are determined to be statistically different, the data usability assessment should alert data users to this inherent variability.

Drying blanks - Based on observations from long-duration sampling events, moisture inside the sample cassettes due to meteorological conditions (e.g., snow, rain, fog) can promote biological growth on sample filters. On the Libby project, the occurrence of biological growth has interfered with direct sample preparation methods. As a result, the laboratory may oven-dry the sets of sample cassettes prior to preparation for analysis when filter conditions warrant. A drying blank is a filter that is dried in the same oven at the same time as the field sample lot. Drying blanks are used to determine if the drying process is a potential source of contamination to field samples. When samples are collected over a long sample duration (e.g., ambient air samples), the field team includes an unopened air cassette in each shipment for the laboratory to use as a drying blank. The cassette will be assigned a unique sample number and a FSDS will be completed for the drying blank. The drying blanks are analyzed for asbestos by the same method that is used for field sample analysis. *The investigation-specific QAPPs will specify the analysis requirements (i.e., the number of grid openings that should be analyzed) for drying blanks.*

Specifics regarding the drying process and the drying blank acceptance criteria are discussed in the most recent revision of Libby-specific laboratory modification form #LB-000055[d]. If any asbestos structures are observed on a drying blank, the laboratory manager will be notified and will take appropriate measures to ensure laboratory staff are employing appropriate sampling handling and processing techniques. In addition, a qualifier of "DB" will be added to the related field sample results in the project database to denote that the associated drying blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.) If asbestos is observed on two consecutively analyzed drying blanks, the drying method will be re-evaluated.

3.1.2 Dust Sampling

Dust samples are no longer routinely collected at the Site. *If dust sampling is required as part of an investigation, the investigation-specific QAPP should specify the appropriate sample collection procedures, equipment needs, equipment calibration procedures, and field QC sample requirements.*

3.1.3 Soil Sampling

3.1.3.1 Collection Procedures

Soil samples collected at the Site for asbestos analysis can be either grab samples or composite samples. Grab samples are samples collected from a single sampling point, and composite samples are collected from multiple sampling points in the same general area and homogenized. At the time of soil sample collection, field teams may also provide a semi-quantitative estimate of the amount of visible vermiculite present at the soil sampling point(s), which can be used to characterize the level of vermiculite contamination (and presumptive LA contamination) in an area. *The investigation-specific QAPPs will specify when visible vermiculite estimates are required as part of soil sample collection.*

[d] Copies of all Libby-specific laboratory modification forms are available on the Libby Lab eRoom (see **Appendix B**).

The following Libby-specific SOPs specify the procedural requirements for the collection of soil samples for investigation activities at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in these SOPs.*

- CDM-LIBBY-05, *Site-Specific SOP for Soil Sample Collection* – This is a Site-specific SOP that provides procedures for the collection of investigation soil samples at the Site including sample location selection.

- CDM-LIBBY-06, *Semi-Quantitative Visual Estimation of Vermiculite in Soil* – This is a Site-specific SOP that provides procedures for the identification and characterization of visible vermiculite in soil at residential and commercial properties.

3.1.3.2 Sampling Equipment

The following is a basic list of equipment needed for soil sample collection (see Section 3.2.4 for a list of general sampling equipment):

- Soil collection equipment – Sampling equipment may include, but is not limited to, a trowel or bulb planter for collection, and a plastic bristle brush for decontamination. When possible re-usable stainless steel equipment will be used for sample collection.

- Hudson sprayer – A Hudson sprayer, or equivalent, is used for dust suppression during sample collection.

- Zip-top plastic bags – Zip-top bags are used as sample containers for soil.

3.1.3.3 Field QC Samples

The only type of field QC sample collected in association with asbestos soil sample collection is a field duplicate. **Table 3-1** summarizes the collection frequency and acceptance criteria for field QC samples. *The investigation-specific QAPPs should specify the applicable collection frequencies and acceptance criteria for field QC samples for soil*.

Field Duplicates – Field duplicates for soil are collected from the same area as the parent sample but from different individual sampling points. These samples are collected independent of the original field sample with separate sampling equipment from a location immediately adjacent to the original field sample. The field duplicate contains the same number of subsamples as the parent sample (i.e., if the parent sample is a 30-point composite, the field duplicate sample is also a 30-point composite).

Soil field duplicate samples will be collected at a rate of 1 per 20 (5%) of the field samples per investigation. It is the responsibility of the FTL to ensure that the appropriate number of field duplicates is collected. Each field duplicate is given a unique sample number, and field personnel record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

If the samples are analyzed by polarized light microscopy (PLM), field duplicate results will be considered concordant if the reported PLM bin result for the field duplicate is within one bin of the original parent field sample. If the samples are analyzed by TEM, field duplicate results will be compared to the parent sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). The variability between the field duplicate and the associated parent field sample reflects the combined variation in sample heterogeneity and the variation due to measurement error. Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability. In general, if the concordance rate for field duplicate samples is less than 20% for the investigation, the data usability assessment should alert data users to this inherent variability.

Note: Following review of equipment rinsate blanks collected in 2002, it was determined that the collection of additional equipment rinsate blanks for soil sampling equipment was no longer necessary. This was because it is not possible to interpret the potential implication of a single LA structure measured in rinsate water by TEM to an associated contamination level for a soil sample measured by PLM. This programmatic change was documented in the *Contaminant Screening Study SAP - Revision 1* (CDM Smith 2004).

3.1.4 Surface Water Sampling

3.1.4.1 Collection Procedures

Surface water samples will be collected, handled, and documented in basic accordance with SOP EPA-LIBBY-2012-08, *Surface Water Sampling*. This SOP specifies the procedural requirements for the collection of water samples for investigation activities at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

Note: A Site-specific SOP (OU3 SOP 3A) has also been developed for the field-filtration of water samples to allow for the estimation of "free" fibers (i.e., fibers that are not bound to organic material in the water) for the purposes of evaluating potential ecological receptor exposures. If this method is to be utilized, *the investigation-specific QAPPs will provide the sampling details and requirements for the collection of field-filtered samples.*

3.1.4.2 Sampling Equipment

The following is a basic list of equipment needed for water sample collection (see Section 3.2.4 for a list of general sampling equipment):

- Collection containers – The water collection container should be a high-density polyethylene (HDPE) wide-mouth container, or equivalent. *The investigation-specific QAPP should specify the water volume requirements.* Use of glass containers should be avoided if samples require shipment to the laboratory prior to filtration.

3.1.4.3 Field QC Samples

The three types of field QC samples collected in association with asbestos water sample collection are field blanks, field duplicates, and/or equipment rinsate blanks. Each type of field QC sample is described in detail below. **Table 3-1** summarizes the collection frequency and acceptance criteria for each type of field QC sample. *The investigation-specific QAPPs should specify the applicable collection frequencies and acceptance criteria for field QC samples for water*.

Field Blanks – Field blanks are collected to evaluate potential contamination during sample collection, shipping and handling, and analysis. The collection frequency for field blanks will be one per field team per day. It is the responsibility of the FTL to ensure that the appropriate number of field blanks is collected. Field blanks for water are samples of water from an uncontaminated source (e.g., store-bought drinking water). At the time of field sample collection, uncontaminated water will be placed in the same type of container as used for the field samples. Field blanks will be given a unique sample number and will be specified as a field blank on the FSDS. One field blank per week, chosen at random by the sample coordinator, is analyzed for each investigation. The field blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. Field blanks will be blind to the laboratory (i.e., the laboratory will not be able to distinguish between field samples and field blanks).

If asbestos is observed on the analyzed field blank, all other field blanks collected by that team during that week will be submitted for analysis to determine the potential impact on the related sample results. If any asbestos structures are observed on a field blank, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.)

Field Duplicates – Field duplicates for water are collected from the same sampling location at the same time as the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. At the time of the parent field sample collection, a second container (i.e., the field duplicate container) will be filled immediately following collection of the parent field sample.

Water field duplicate samples will be collected at a rate of 1 per 20 (5%) of the field samples per investigation. It is the responsibility of the FTL to ensure that the appropriate number of field duplicates is collected. Each field duplicate is given unique sample number, and field personnel record the Sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability. In general, if

more than 20% of field duplicate samples for an investigation are determined to be statistically different, the data usability assessment should alert data users to this inherent variability.

Equipment Rinsate Blanks – If reusable sampling equipment is utilized, equipment rinsate blanks will be collected after decontamination of field equipment. The decontaminated equipment should be rinsed with clean water (e.g., store-bought drinking water), and the resulting rinsate should be collected in the same type of container as utilized for the associated field samples. At least one equipment rinsate blank should be collected per equipment decontamination effort. It is the responsibility of each field team to collect the appropriate number of equipment rinsate blanks. Equipment rinsate blanks should be labeled with a unique sample number and submitted for analysis by TEM. *The investigation-specific QAPP will specify the TEM analytical requirements for equipment rinsate blanks.*

If any asbestos structures are observed in the equipment rinsate blank, the FTL will be notified and will take appropriate measures to ensure field staff is employing proper decontamination techniques. In addition, a qualifier of "EB" will be added to the related field sample results in the project database to denote that the associated equipment rinsate blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.)

3.1.5 Bulk Material Sampling

3.1.5.1 Collection Procedures

Bulk material samples (e.g., insulation) will be collected when vermiculite additives are identified within a building material, and only if that material is friable (i.e., able to be pulverized by hand). Bulk material samples will be collected in compliance with Asbestos Hazard Emergency Response Act (AHERA) sampling requirements provided in 40 Code of Federal Regulations (CFR) 763.86. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in AHERA.*

3.1.5.2 Sampling Equipment

The following is a basic list of equipment needed for bulk material collection (see Section 3.2.4 for a list of general sampling equipment):

- Hudson sprayer – A Hudson sprayer, or equivalent, is used for dust suppression during sample collection.
- Zip-top plastic bags – Zip-top bags are used as sample containers for bulk materials.

3.1.5.3 Field QC Samples

Field QC samples are not required for bulk materials, *unless specified otherwise in the investigation-specific QAPPs.*

3.1.6 Duff Material Sampling

3.1.6.1 Collection Procedures

"Duff" consists of the un-decomposed twigs, pine needles, and other vegetation and the layer of partially- to fully-decomposed litter that occurs on top of the mineral soil. At the Site, duff samples are collected, handled, and documented in basic accordance with Site-specific SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos*. In brief, duff material is collected by hand at a selected field location and placed in a plastic bag for shipment to the analytical laboratory. During collection, care is taken to ensure that the top layer of soil beneath the organic debris is not included in the duff sample.

The SOP EPA-LIBBY-2012-11 specifies the procedural requirements for the collection of duff samples for investigation activities at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

3.1.6.2 Sampling Equipment

The following is a basic list of equipment needed for duff sample collection (see Section 3.2.4 for a list of general sampling equipment):

- Zip-top plastic bags – Zip-top bags are used as sample containers for duff materials. The amount of sample material collected will depend upon the amount of duff material present. As needed, multiple bags may be used for a single sample.

3.1.6.3 Field QC Samples

The two types of field QC samples that may be collected in association with asbestos duff sample collection are field blanks and field duplicates. Each type of field QC sample is described in detail below. **Table 3-1** summarizes the collection frequency and acceptance criteria for each type of field QC sample. *The investigation-specific QAPPs should specify the applicable collection frequencies and acceptance criteria for field QC samples for duff.*

Field Blanks – Field blanks are collected to evaluate potential contamination during sample collection, shipping and handling, and analysis. Field blanks for duff are samples of duff material from an uncontaminated area (e.g., an off-site location). The collection of field blanks is not required for duff. If field blank collection is deemed necessary for the purposes of a specific investigation, *the investigation-specific QAPPs will identify where field blanks should be collected and the frequency that they should be collected.* If collected, it is the responsibility of the FTL to ensure that the appropriate number of field blanks is collected. Field blanks will be given a unique sample number and will be specified as a field blank on the FSDS. The field blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. Field blanks will be blind to the laboratory (i.e., the laboratory will not be able to distinguish between field samples and field blanks).

If any asbestos structures are observed on a field blank, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample

results in the project database to denote that the associated field blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.)

Field Duplicates – Field duplicates for duff are collected from a sampling location in close proximity to and of similar size as the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. Duff field duplicate samples will be collected at a rate of 1 per 20 (5%) of the field samples per investigation. It is the responsibility of the FTL to ensure that the appropriate number of field duplicates is collected. Each field duplicate is given unique sample number, and field personnel record the Sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

If duff samples are analyzed by TEM, field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). If duff samples are analyzed by PLM, results will be considered concordant if the reported PLM bin result for the field duplicate is within one bin of the original parent field sample. Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, the results are used to determine the magnitude of this variability to evaluate data usability. In general, if more than 20% of field duplicate samples for an investigation are determined to be statistically different, the data usability assessment should alert data users to this inherent variability.

3.1.7 Tree Bark Sampling

3.1.7.1 Collection Procedures

At the Site, tree bark samples are collected, handled, and documented in basic accordance with Site-specific SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos*. In brief, tree bark is collected by using a hole saw to cut a circular ring in the bark down to the tree cambium, which is then cut from the tree using a sharp chisel. The resulting tree bark "plug" is placed in a plastic bag for shipment to the analytical laboratory.

The SOP EPA-LIBBY-2012-12 specifies the procedural requirements for the collection of tree bark samples for investigation activities at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

3.1.7.2 Sampling Equipment

The following is a basic list of equipment needed for tree bark sample collection (see Section 3.2.4 for a list of general sampling equipment):

- Aerosol hairspray – Prior to sample collection, the area to be sampled is sprayed with hairspray in order to minimize the potential for loss of fibers from the tree bark surface.

- Battery-powered drill and hole saw – The drill and hole saw (2-inch diameter) are used to create a circular plug in the tree. The depth of the plug will depend upon the thickness of the tree bark.

- Chisel – The chisel is used to remove the circular plug from the tree.

- Zip-top plastic bags – Zip-top bags are used as sample containers for tree bark plugs.

3.1.7.3 Field QC Samples

There are three types of field QC samples that may be collected in association with tree bark sample collection, including field blanks, field duplicates, and equipment rinsate blanks. Each type of field QC sample is described in detail below. **Table 3-1** summarizes the collection frequency and acceptance criteria for each type of field QC sample. *The investigation-specific QAPPs should specify the applicable collection frequencies and acceptance criteria for field QC samples for tree bark*.

Field Blanks – Field blanks are collected to evaluate potential contamination during sample collection, shipping and handling, and analysis. Field blanks for tree bark are samples of bark from an uncontaminated tree (e.g., an off-site location). The collection of field blanks is not required for tree bark. If field blank collection is deemed necessary for the purposes of a specific investigation, *the investigation-specific QAPPs will identify where field blanks should be collected and the frequency that they should be collected.* If collected, it is the responsibility of the FTL to ensure that the appropriate number of field blanks is collected. Field blanks will be given a unique sample number and will be specified as a field blank on the FSDS. The field blanks will be analyzed for asbestos fibers by the same method as will be used for field sample analysis. Field blanks will be blind to the laboratory (i.e., the laboratory will not be able to distinguish between field samples and field blanks).

If any asbestos structures are observed on a field blank, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.)

Field Duplicates – Field duplicates for tree bark are collected from the same tree as and in close proximity to (within 6 inches) the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. Tree bark field duplicate samples will be collected at a rate of 1 per 20 (5%) of the field samples per investigation. It is the responsibility of the FTL to ensure that the appropriate number of field duplicates is collected. Each field duplicate is given unique sample number, and field personnel record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically,

there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability. In general, if more than 20% of field duplicate samples for the investigation are determined to be statistically different, the data usability assessment should alert data users to this inherent variability.

Equipment Rinsate Blanks - If reusable sampling equipment is utilized, equipment rinsate blanks will be collected after decontamination of field equipment. The decontaminated equipment (i.e., hole saw, chisel) should be rinsed with clean water (e.g., store-bought drinking water), and the resulting rinsate should be collected in an HDPE container. At least one equipment rinsate blank should be collected per equipment decontamination effort. It is the responsibility of each field team to collect the appropriate number of equipment rinsate blanks. Equipment rinsate blanks should be labeled with a unique sample number and submitted for analysis by TEM. *The investigation-specific QAPP will specify the TEM analytical requirements for equipment rinsates.*

If any asbestos structures are observed in the equipment rinsate, the FTL will be notified and will take appropriate measures to ensure field staff is employing proper decontamination techniques. In addition, a qualifier of "EB" will be added to the related field sample results in the project database to denote that the associated equipment blank had asbestos structures detected. (See Section 6.4 for additional information on data qualifiers.)

3.1.8 Sediment Sampling

3.1.8.1 Collection Procedures

Sediment samples collected at the Site for asbestos analysis can be either grab samples or composite samples. Grab samples are samples collected from a single sampling point, and composite samples are collected from multiple sampling points in the same general area and homogenized. At the time of sediment sample collection, field teams may also provide a semi-quantitative estimate of the amount of visible vermiculite present at the soil sampling point(s), which can be used to characterize the level of vermiculite contamination (and presumptive LA contamination) in an area. *The investigation-specific QAPPs will specify when visible vermiculite estimates are required as part of sediment sample collection and how these visible estimates should be made.*

Sediment samples will be collected, handled, and documented in basic accordance with SOP EPA-LIBBY-2012-09, *Sediment Sampling*. This SOP specifies the procedural requirements for the collection of sediment samples for investigation activities at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

3.1.8.2 Sampling Equipment

The following is a basic list of equipment needed for sediment sample collection (see Section 3.2.4 for a list of general sampling equipment):

- Sediment collection equipment – Sampling equipment may include, but is not limited to, spoons, trowels, and buckets, ponar dredges, or other deep-water collection devices, and

a plastic bristle brush for decontamination. When possible re-usable stainless steel equipment will be used for sample collection.

- Collection containers – The sediment collection container should be an HDPE wide-mouth container, or equivalent. Use of glass containers should be avoided, especially if samples require shipment.

3.1.8.3 Field QC Samples

The only type of field QC sample collected in association with asbestos sediment sample collection is a field duplicate. **Table 3-1** summarizes the collection frequency and acceptance criteria for field QC samples. *The investigation-specific QAPPs should specify the applicable collection frequencies and acceptance criteria for field QC samples for sediment*.

Field Duplicates – Field duplicates for sediment are collected from the same area as the parent sample but from different individual sampling points. These samples are collected independent of the original field sample with separate sampling equipment from a location immediately adjacent to the original field sample. The field duplicate contains the same number of subsamples as the parent sample (i.e., if the parent sample is a 30-point composite, the field duplicate sample is also a 30-point composite).

Sediment field duplicate samples will be collected at a rate of 1 per 20 (5%) of the field samples per investigation. It is the responsibility of the FTL to ensure that the appropriate number of field duplicates is collected. Each field duplicate is given a unique sample number, and field personnel record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same location ID is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

If the samples are analyzed by PLM, field duplicate results will be considered concordant if the reported PLM bin result for the field duplicate is within one bin of the original parent field sample. If the samples are analyzed by TEM, field duplicate results will be compared to the parent sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). The variability between the field duplicate and the associated parent field sample reflects the combined variation in sample heterogeneity and the variation due to measurement error. Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability. In general, if the concordance rate for field duplicate samples is less than 20% for the investigation, the data usability assessment should alert data users to this inherent variability.

Note: As noted previously in Section 3.1.3.3, equipment rinsate blanks are no longer collected for soil (or sediment). This programmatic change was documented in the *Contaminant Screening Study SAP - Revision 1* (CDM Smith 2004).

3.2 General Field Processes

This section describes the general field processes used at the Site for all investigation activities and associated QA/QC measures related to these processes.

In general, QA/QC at the level of the field is maintained by:

- Providing appropriate training of field staff
- Conducting periodic evaluations of staff adherence to governing documents
- Following the QA/QC procedures defined in the investigation-specific QAPPs and the field SOPs
- Performing equipment calibration and data checks
- Submitting field QC samples
- Following equipment decontamination procedures

3.2.1 Drafting and Approval of Governing Documents

All project planning documents are subject to a review by the project management team before they are considered final. For all OUs, draft documents are submitted to the EPA project management team, including the project team leader, TAU chief, appropriate EPA RPM, the LC, and the Libby Data Manager. In the case of OU3, draft documents are also reviewed by W.R. Grace project management staff and their field contractors.

The project management team will review documents to ensure the specified DQOs will be met when the field program is implemented as described in the submitted document and will make recommendations for revision and/or clarifications. Before sampling may begin, the project management team will provide approval of the investigation-specific QAPP by signing and dating the document approval page. It is the responsibility of the FTL to ensure that any governing documents are approved by the project management team prior to implementation.

Approved copies of all governing documents related to an investigation are available in the EPA Superfund Records Center and at the EPA Libby Information Center. Electronic copies of all governing documents are also maintained on various electronic repositories (e.g., eRooms, websites). **Appendix B** summarizes the various electronic repositories that are also utilized to maintain and allow access to copies of all governing documents for the Site.

For investigation-specific QAPPs where asbestos analysis is required, an Analytical Requirements Summary Sheet (see **Appendix C** for an example template) will be prepared to identify the types of samples that will be collected and the required preparation and analysis methods for each type of sample. The LC will provide a copy of the draft Analytical Requirements Summary Sheet to the laboratories to allow for input on proposed analytical requirements prior to the finalization of the investigation-specific QAPP. Each laboratory will electronically sign the Analytical Requirements Summary Sheet to acknowledge that they have reviewed and understand the preparation and analytical requirements. The LC will maintain

copies of all active Analytical Requirements Summary Sheets in the Libby Lab eRoom (see **Appendix B**). The LC is responsible for informing the laboratories of any Analytical Requirements Summary Sheets revisions. A copy of the investigation-specific Analytical Requirements Summary Sheet will accompany each COC.

All governing documents related to an investigation must be maintained by the FTL, and be in the possession of team members who are conducting the field work related to that investigation. When necessary, final documents may be revised and reissued if significant changes to the investigation occur. Any revised documents are subject to review by the project management team.

3.2.2 Field Planning Meetings

Prior to the start of any new investigation sampling activities, a field planning meeting will be conducted by the assigned investigation-specific FTL and attended by the field staff, the field QAM, the field sample coordinator, and the H&S manager. The EPA project team leader and appropriate EPA RPM(s) or MDEQ PM will be notified of the field planning meeting date and time. The agenda will be reviewed and approved by the field QAM and the H&S manager prior to the meeting. The meeting will briefly discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Applicable SOPs, schedule of events, and individual assignments
- Required field QC measures
- H&S requirements
- Documents governing fieldwork that must be on-site
- Any changes in the field planning documents

Additional meetings will be held when required by the documents governing fieldwork or when the scope of the assignment changes. The field team personnel will perform the following activities before and during field activities, as applicable:

- Review and understand applicable governing documents
- Ensure that all sample analyses are scheduled through the LC
- Obtain required sample containers and other supplies
- Obtain and check field sampling equipment
- Obtain and maintain personal PPE

3.2.3 Field Team Training Requirements

Prior to starting any field work, any new field sampling team member should complete the following:

Training Requirement	Location of Documentation Specifying Training Requirement Completion
Read and understand the governing HASP(s)	HASP signature sheet Required reading report sheet
Attend an orientation session with the Site H&S manager	Orientation session attendance sheet
Read and understand all relevant governing documents (e.g., investigation-specific QAPPs, SOPs)	Required reading report sheet
Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and relevant 8-hour refreshers	OSHA training certificates
Current 40-hour HAZWOPER medical clearance	Physician letter in the field personnel files
Respiratory protection training, as required by 29 CFR 1910.134	Training certificate
Asbestos awareness training, as required by 29 CFR 1910.1001	Training certificate
Sample collection techniques	Orientation session attendance sheet Field planning meeting attendance sheet

The investigation-specific QAPPs will specify if any of the above training requirements can be waived for the purposes of the particular investigation. All training documentation will be stored in the appropriate field office. It is the responsibility of the field H&S manager to ensure that all training documentation is up-to-date and on-file for each field team member.

3.2.4 Inventory and Procurement of Equipment and Supplies

Prior to initiation of any sampling activities, the investigation-specific FTL will determine the necessary equipment and supplies to conduct sampling activities. *The investigation-specific QAPPs will summarize any specialized equipment and supplies needed.* Any required equipment not already contained in the field equipment supply inventory will be procured.

The following list summarizes the general equipment and supplies required for most investigations:

Sampling equipment – See Section 3.1 for medium-specific sampling equipment lists.

Field logbook – Used to document field sampling activities and any problems in sample collection or deviations from the investigation-specific QAPPs. See Section 3.2.5 for standard procedures for field logbooks.

Field sample data sheets (FSDSs) – FSDSs are medium-specific forms that are used to document sample details (i.e., sampling location, Sample number, medium, field QC type, etc.). *The investigation-specific QAPPs will identify the appropriate FSDSs to be used for each investigation*. For all OUs, these FSDS forms are hardcopy. See Section 3.2.6 for standard procedures for the completion of FSDSs.

Sample number labels – *Unless specified otherwise in the investigation-specific QAPPs,* sample numbers are sequential numbers with investigation-specific prefixes. For example, samples collected as part of the ambient air program have a sample number of AA-#####; where AA represents the ambient air program sample number prefix and ##### is a five digit sequential number. *The investigation-specific QAPPs will identify the sample number prefixes to be used for each investigation*. Sample number labels are pre-printed and checked out to the field teams by the FTL or their designate. To avoid potential transcription errors in the field, multiple labels of the same sample number are prepared – one label is affixed to the collected sample, one label is affixed to the FSDS (if hardcopy FSDS forms are utilized). Labels may also be affixed to the field logbook or other investigation-specific forms.

Indelible ink pen, permanent marker – Indelible ink pens are used to complete required manual data entry of information on the FSDS and in the field logbook (pencil may not be used). Permanent markers may be used to write sample numbers on the sample container if pre-printed labels are not available.

PPE - As required by the HASP.

Land survey map or aerial photo – Used to identify appropriate sampling locations. In some cases, sketches may be added to the map/photo to designate sampling and visual inspection locations and other site features.

Digital camera – Used to document sampling locations and conditions. See Section 3.2.8 for standard procedures in photographic documentation.

Global positioning system (GPS) unit, measuring wheel, stakes – Used to identify and mark sampling locations. See Section 3.2.9 for standard procedures in GPS documentation.

Zip-top bags - Zip-top bags are used as sample containers for most types of environmental samples (see Section 3.1). Sample number labels will be affixed to the bags or the sample number will be hand-written in permanent marker on the bags.

Decontamination equipment – Used to remove any residual asbestos contamination on reusable sampling equipment between the collection of samples. See Section 3.2.11 for standard procedures in equipment decontamination.

3.2.5 Field Logbooks

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing plans and observations related to investigation-specific QAPPs. Field logbooks will be maintained in general conformance with SOP EPA-LIBBY-2012-01, *Field Logbook Content and Control*. This SOP specifies the procedural requirements for field logbooks. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

Separate field logbooks will be kept for each investigation and the cover of each field logbook will clearly indicate the name of the investigation and its sequence number.

Field logbooks will be completed for each investigation activity prior to leaving a sampling location. Field logbooks will be checked for completeness and adherence to SOP requirements on a daily basis by the FTL or their designate for the first week of each investigation. When incorrect field logbook completion procedures are discovered during these checks, the errors will be discussed with the author of the entry and corrected. Erroneous information recorded in a field logbook will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

Field logbook checks will be extended to once per month as investigation activities continue, and any errors noticed during the checks will be discussed with the author and corrected. If investigation activities continue beyond 6 months, the frequency of assessing field logbook entries will be established by the field QAM or their designate.

The field administrative staff will manage the field logbooks by assigning unique identification numbers to each field logbook, tracking to whom and the date each field logbook was assigned, the general investigation activities recorded in each field logbook (e.g., ambient air monitoring), and the date when the field logbook was returned. As field logbooks are completed, originals will be catalogued and maintained by the field administrative staff in their respective field office.

For OU3, scanned copies of all field logbooks are posted to the Libby OU3 eRoom (see **Appendix B**). For all other OUs, *unless specified otherwise in the investigation-specific QAPP,* scanned copies of field logbooks are maintained on the local servers for the CDM Smith offices in Libby and Denver.

3.2.6 FSDSs

Medium-specific FSDSs developed for use at the Site will be used to record detailed sample information for each collected sample[e]. Use of standardized forms ensures consistent documentation across samplers. For OU3 the FSDS form completion differs somewhat that the other OUs, and FSDS procedures specific to OU3 are discussed separately below.

FSDS information is completed in accordance with the procedures specified in SOP CDM-LIBBY-03. Hardcopy FSDSs are medium-specific and location-specific and provide a standard format for documenting field sampling information. *The investigation-specific QAPPs will include information on the appropriate FSDS that should be utilized for each sampled medium, will provide any additional requirements, and document any deviations from the procedures described below.*

Hardcopy FSDSs allow for the entry of up to three individual samples from the same location on the same FSDS form. If columns are left incomplete due to fewer than three samples being recorded on a sheet, the blank columns will be crossed out, dated, and signed by the field team member completing the FSDS. Erroneous information recorded on a hardcopy FSDS will be

[e] Soil FSDS forms are also used to assign location IDs for properties where inspections have occurred but no samples are collected. In this special instance, all sample columns are crossed out, dated, and signed by the field team member completing the FSDS.

corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

FSDS information will be completed in the field before field personnel leave the sampling location. To ensure that all applicable data is accurately entered and all fields are complete, a different field team member will check each FSDS. The team member completing the hardcopy form and the team member checking the form will initial the FSDS in the proper fields. In addition, the FTL will also complete periodic checks of FSDSs prior to relinquishment of the samples to the field sample coordinator. Once FSDSs and samples are relinquished to the field sample coordination staff, the FSDSs are again checked for accuracy and completeness when data are input into the local Scribe field database. Refer to Section 6 for further details on field data management procedures.

If a revision is required to the hardcopy FSDS during any of these checks, it will be returned to the field team member initially responsible for its completion. The error will be explained to the team member and the FSDS corrected. If the team member is no longer on site, revisions will be made by sample coordination staff or the FTL. It is the responsibility of the field data manager to make the appropriate change in the local Scribe field database.

Each hardcopy FSDS is assigned a unique sequential number. This number will be referenced in the field logbook entries related to samples recorded on individual sheets. Field administrative staff will manage the hardcopy FSDSs in their respective field office. Original FSDSs will be filed by medium and FSDS number; an additional copy will be placed in relevant property folders.

Unless specified otherwise in the investigation-specific QAPP, hardcopies of FSDSs are maintained in the project files located in the CDM Smith office in Libby. Hardcopies of all FSDS forms are also sent to the CDM Smith office in Denver for archive. *The investigation-specific QAPPs will specify if it is necessary to manage scanned copies of FSDS forms in the Libby Field eRoom* (see **Appendix B**).

OU3

For OU3, the FSDS procedures are generally similar to those specified above, except that hardcopy FSDS forms are often modified to be specific to the various investigation-specific programs. *The investigation-specific QAPPs will include information on the appropriate FSDS that should be utilized for each sampled medium.* In addition, scanned copies of all FSDSs are posted to the Libby OU3 eRoom (see **Appendix B**).

3.2.7 Investigation-Specific Field Forms

Investigation-specific field forms may be required as new investigation activities are designed and new data needs are determined. *Investigation-specific field forms will be included as an appendix in the investigation-specific QAPPs. The investigation-specific QAPPs will also include a discussion for form maintenance and distribution.*

Each investigation-specific field form will be checked for accuracy and completeness by a second team member before being relinquished to either the FTL or the sample coordination staff, as appropriate. Field forms will be checked for completeness and accuracy by the FTL or their designate on a daily basis for the first week of each new investigation. Field form checks

will be extended to once per month as investigation activities continue. If investigation activities continue beyond 6 months, the frequency of assessing field forms will be established by the field QAM or their designate.

If during any of these checks a revision is required to the form, it will be returned to the team member initially responsible for its completion. The error will be explained to the team member and the sheet corrected. If the team member is no longer on site, revisions will be made by sample coordination staff or the FTL.

3.2.8 Photographic Documentation

Photographic documentation will be collected with a digital camera *as required by the investigation-specific governing documents*, and at any other place the field sampling personnel determine necessary (e.g., to document unusual sampling conditions). Photographic documentation will be performed in general conformance to SOP EPA-LIBBY-2012-02, *Photographic Documentation of Field Activities*. This SOP specifies the procedural requirements for photographic documentation. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

3.2.9 Global Positioning System Point Collection

GPS points will be collected in basic accordance with SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling*. This SOP specifies the procedural requirements for the collection of GPS points in support of Site investigations. *The investigation-specific QAPPs will specify any requirements for the collection of GPS points and the equipment to be used, and provide any additional requirements and document any deviations from the procedures described in this SOP.*

Field-collected GPS data are converted to a usable geographic information system (GIS) format using the general processes described in SOP CDM-LIBBY-09. After the conversion from GPS points to GIS files, all of the GPS data points are checked visually to identify any potential data entry errors or missed points. Once the data have been field reviewed, GPS data are loaded to the appropriate Scribe field project.

Field Equipment Maintenance

All field equipment is maintained in basic accordance with manufacturer specifications and SOP EPA-LIBBY-2012-03, *Control of Measurement and Test Equipment*. This SOP specifies the procedural requirements for field equipment maintenance at the Site. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

When a piece of equipment is found to be operating incorrectly, the piece of equipment will be labeled “out of order” and placed in a separate area from the rest of the sampling equipment. The person who identified the equipment as “out of order” will notify the FTL overseeing the investigation activities. It is the responsibility of the FLT to facilitate repair of the out-of-order equipment. This may include having appropriately trained field team members complete the repair or shipping the malfunctioning equipment to the manufacturer. Field team members will have access to basic tools required to make field acceptable repairs. This will ensure timely repair of any “out of order” equipment.

3.2.10 Equipment Decontamination

Equipment used to collect, handle, or measure environmental samples will be decontaminated in basic accordance with SOP EPA-LIBBY-2012-04, *Field Equipment Decontamination.* This SOP specifies the procedural requirements for equipment decontamination. Additional equipment decontamination procedures are also specified in the respective sample collection SOPs (see Section 3.1). *The investigation-specific QAPPs will specify any additional decontamination procedures for sampling equipment and will document any deviations from the procedures described in this SOP.*

3.2.11 Handling IDW

Any disposable equipment or other IDW will be handled in general conformance with SOP EPA-LIBBY-2012-05, *Handling Investigation-Derived Waste.* This SOP specifies the procedural requirements for IDW handling. *The investigation-specific QAPPs will specify any additional IDW handling procedures and will document any deviations from the procedures described in this SOP.*

During periodic reviews conducted by the FTL, IDW handling procedures will be evaluated. If field teams are observed not to be following the handling procedures specified in the SOP, the field teams will be re-instructed on correct handling procedures.

3.2.12 Field Sample Custody and Documentation

The COC is used as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A complete COC record is required to accompany each shipment of samples. COC procedures will follow the requirements as stated in SOP EPA-LIBBY-2012-06, *Sample Custody.* This SOP specifies the procedural requirements for sample custody and documentation. *The investigation-specific QAPPs will specify any additional procedures and will document any deviations from the procedures described in this SOP.*

In brief, at the end of each day, all samples will be relinquished to the field sample coordinator or a designated secure storage location by the sampling team following COC procedures, and an entry will be made into the field logbook indicating the time samples were relinquished and the sample coordinator who received the samples. The field sample coordinator will follow COC procedures to ensure proper sample custody between acceptance of the sample from the field teams to delivery or shipment to the laboratory.

<u>Procedures for OU3 investigations</u>

The field sample coordinator will prepare a hardcopy COC form using the 3-page carbon copy forms developed specifically for use in OU3 investigations. One copy of the COC will be retained by the field sample coordinator and the other two copies of the COC will accompany the sample shipment. The LC will instruct the field sample coordinator as to the appropriate laboratory for each sample shipment.

If any errors are found on a COC after shipment, the hardcopy of the COC retained by the field sample coordinator will be corrected and a corrected COC will be provided to the LC (Remedium) for distribution to the appropriate laboratory.

Procedures for non-OU3 investigations

For all other OUs, a member of the sample coordination staff will manually enter sample information from the hardcopy FSDS into the local Scribe field project database using a series of standardized data entry forms developed in Microsoft Access by ESAT, referred to as the sample Data Entry Tool, or the "DE Tool". The DE Tool has a variety of built-in QC functions that improve accuracy of data entry and help maintain data integrity. After the data entry is checked against the hardcopy FSDSs (by a different sample coordination staff member than completed the original data entry), the DE Tool is used to prepare an electronic COC. A three-page carbon copy COC will be generated from the electronic COC. The field sample coordinator will retain one hardcopy of the COC for the project file; the other two hard copies of the COC will accompany the sample shipment.

If error are detected on a COC after shipment, all changes and notification must be as described in the most recent revision of the Libby Chain of Custody Documentation SOP (SOP No. ER8-LIBBY-01)

3.2.13 Sample Packaging and Shipping

Samples will be packaged and shipped in general accordance with SOP EPA-LIBBY-2012-07, *Packaging and Shipping of Environmental Samples.* This SOP specifies the procedural requirements for sample packaging and shipping. *The investigation-specific QAPPs will provide any additional requirements and document any deviations from the procedures described in this SOP.*

For air samples, a custody seal will be placed so that both end caps of the sampling cassette are covered by the seal but will not obstruct the sample number. *Unless otherwise stated in the investigation-specific QAPP,* custody seals are not typically required for individual samples for other media (e.g., soil); instead, seals will be placed over at least two sides of the shipping cooler and then secured by tape. Prior to sealing the shipping container, the sample coordinator will perform a final check of the contents of the shipment with the COC, sign and date the designated spaces at the bottom of the COC. The field sample coordinator will then place the custody seals on the shipping container.

The field sample coordinator will be responsible for sending samples to the appropriate location, as specified by the LC. For OU3, the LC will specify the appropriate analytical laboratory for sample shipment. For non-OU3, with the exception of samples that are hand-delivered to the EMSL Mobile Lab in Libby, all samples will be sent to the Troy SPF for sample preparation (soil only), and/or subsequent shipment to the appropriate analytical laboratory, or archive.

Samples will be hand-delivered, picked up by a courier service, or shipped by a delivery service to the designated location, as applicable. For hand-deliveries and courier pickups, samples will be packaged for transit such that they are contained and secure (i.e., will not be excessively jostled). Clean plastic totes with the lids secured or sample coolers may be used for this purpose. For samples requiring shipment, an established overnight delivery service provider (e.g., Federal Express) will be used.

3.2.14 Record of Modification Forms

All deviations from investigation-specific guidance documents will be recorded on the appropriate Libby Record of Modification (ROM) Form (see **Appendix D** for example templates). The ROM forms will be used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation work that have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) will be documented in the field logbooks. Field ROMs are completed by the FTL overseeing the investigation/activity, or by assigned field or technical staff. As modifications to governing documents are implemented, the FTL will communicate the changes to the field teams conducting activities associated with the modification. When the project management team determines the need, revised governing documents may be issued to incorporate modifications.

For OU3, each completed field ROM is assigned a unique number that is specific to each investigation-specific QAPP (e.g., Phase I LFM-OU3-02) by the OU3 CDM Smith PM or their delegate. Once a form is prepared, it is submitted to the OU3 EPA RPM for review and approval. Copies of all approved ROMs are available on the Libby OU3 website (see **Appendix B**).

For all other OUs, each completed field ROM is assigned a unique sequential number (e.g., LFO-000026) by the CDM Smith field QAM. A ROM tracking log for all field modifications is maintained by the field QAM. This tracking log briefly describes the ROM being documented, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the appropriate EPA RPM for review and approval. Copies of approved field ROMs are available in the Libby Field eRoom (see **Appendix B**).

3.2.15 Field Surveillances and Audits

The quality of field processes is evaluated by field surveillances and audits. This section describes each of these evaluations.

3.2.15.1 Field Surveillances

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. Investigation-specific field surveillances may be conducted for each investigation activity conducted at the Site, and are most often performed by the field QAM.

The schedule for performing field surveillances is dependent on the duration of the investigation, frequency of execution, and magnitude of process changes. Typically, a field surveillance will be performed during the first week of a new field program. Thereafter, surveillances may be conducted once a month or as necessary when field processes are revised or other QA/QC procedures indicates the possibility of deficiencies.

When deficiencies are observed during the surveillances, the observer will immediately discuss the observation with the field team member and coordinate corrective measures with the FTL, if required. If the observer finds deficiencies across multiple field team members or teams, the

FTL will plan and hold a field meeting. At this meeting the observations made will be discussed and any corrective actions required, (e.g., retraining) will be reviewed.

The observer will document that field surveillances have occurred using a field surveillance checklist. This investigation-specific checklist should consist of a 1-2 page overview of who performed the surveillance, when it was completed, what sampling program was being evaluated, any governing document(s), the types of activities that were evaluated, any deficiencies that were noted, and recommended corrective actions to address the noted deficiencies. This checklist will also be used to record any field meetings that were conducted including topics discussed, person conducting the meeting, and field team members attending the meeting. A copy of this checklist will be provided to the EPA RPM and the QATS contractor.

3.2.15.2 Field Audits

Field audits are broader in scope than field surveillances. Audits are evaluations conducted by qualified technical or QA staff that are independent of the activities audited. Field audits can be conducted by field contractors, internal EPA staff, or EPA contracted auditors. For OU3, field oversight audits are performed by HDR at the direction of the EPA RPM. It is the responsibility of the EPA RPM to ensure that field auditing requirements are met for each investigation.

A field audit is typically conducted during the early stages of an investigation to identify any early deficiencies so that any impact on project data quality is limited. Typically, at least one field audit is conducted on investigation activities that have a project duration of one year.

Field audit findings are documented in audit reports issued by the entity performing the audit, and are often discussed with the project management team before the auditors leave the Site. Corrective actions will be immediately implemented, as appropriate. A copy of the field audit report will be provided to the EPA RPM and the QATS contractor.

Section 4 Analytical Laboratory Methods and Requirements

This section summarizes the QA/QC objectives and procedures used in the analytical laboratory program for the Site. The following section discusses the common types of analytical methods used for investigation samples, the project-specific analytic SOPs and method deviations to commercial testing standards, and the QA/QC procedures associated with each analytical method. This is followed by discussion of general laboratory QA practices utilized at the Site.

The analytical procedures discussed below are intended to summarize the basic requirements for sample analysis at the Site. *The investigation-specific QAPPs should clearly identify any deviations from the procedures as described below, as well as any specific analytical methods and requirements that are not provided in this section.*

4.1 Analytical Methods

There are three different types of microscopy techniques that are frequently utilized at the Site to analyze for asbestos in support of investigation activities – PCM, TEM, and PLM. The most recent versions of all referenced analysis methods and SOPs are available in the Libby Lab eRoom (see **Appendix B**).

The following sections provide a general description of each microscopy technique and summarize the typical analytical methods utilized, including any project-specific method modifications and the project-specific QA/QC requirements. The analytical methods should be consulted for detailed descriptions of method-required QA/QC measures. *The investigation-specific QAPPs will specify the required analytical methods and procedures for each type of sample collected as part of the investigation.*

4.1.1 Phase Contrast Microscopy (PCM)

The National Institute of Occupational Safety and Health (NIOSH) Method 7400 (Issue 2), *Asbestos and Other Fibers by PCM*, is the historical technique used for the measurement of asbestos fibers in air and is the method upon which many occupational exposure regulations are based. A key limitation of PCM is that structure discrimination is based only on size and shape. Because of this, it is not possible to distinguish between asbestos and non-asbestos structures. All structures that have a length greater than 5 µm and have an aspect ratio (length:width) of 3:1 or more are counted as PCM fibers. The limit of resolution of PCM is about 0.25 µm, so structures thinner than this are generally not observable. Also, there is no upper width restriction imposed.

At the Site, PCM is typically used as the primary analysis method for worker air samples collected as part of H&S monitoring. This is because results for these samples are compared to OSHA exposure limits that are based on PCM.

4.1.1.1 Project-Specific SOPs and Method Modifications

At the Site, the PCM method has been modified and clarified by the most current revision of the following permanent project-specific laboratory modifications:

- LB-000015 – This modification establishes the overload rejection criteria for the project at 25%, documents the selection of indirect preparation procedure to be used (if applicable), and the PCM counting methods utilized.

- LB-000091 – The purpose of this modification is to describe modifications to the TEM Indirect Preparation SOP (EPA-Libby-08).

4.1.1.2 QA/QC Procedures

General Procedures

Laboratory-based QA/QC for PCM is maintained by following the requirements specified in the method and through satisfactory completion of the requirements in the American Industrial Hygiene Association (AIHA) Industrial Hygiene Laboratory Accreditation Program (IHLAP). This laboratory accreditation is designed specifically for laboratories who are involved in analyzing samples that are used to evaluate workplace exposure. The IHLAP requirement areas include personnel qualifications, participation in AIHA Proficiency Analytical Testing (PAT) program for all categories of analytes performed by the laboratory, adequate testing facilities, QC procedures including records of on-site airborne asbestos analyses, laboratory records and recordkeeping system, method review program, and on-site audits performed every 2 years. Current copies of AIHA certifications from the contracted asbestos testing laboratories are submitted to the LC for the contract files.

In accordance with the NIOSH 7400 method, microscope and phase ring alignment checks are conducted daily, resolution checks using a Health and Safety Executive/National Physical Laboratory slide (referred to as an HSE/NPL slide) are conducted weekly, and a field area determination of the Walton Beckett graticule is conducted monthly. Reagents are checked for contamination whenever a new batch is started. Laboratory QC analyses include the successful reading of a known reference slide daily and a minimum 10% re-analysis of samples read. It is the responsibility of the laboratory QAM to ensure that these QA/QC assessments are conducted at the specified frequency and that results are recorded in the laboratory logbooks. Copies of all QA/QC assessment results are submitted directly to the LC by the laboratory manager. Results for laboratory QC analyses should also be included (and clearly identified as QC) in the electronic deliverable for each laboratory job. It is the responsibility of the LC to notify the QATS contractor of any issues identified during these QA/QC assessments.

Laboratories may also conduct annual internal QC audits that are performed by a senior staff member, QA director, or representative from their corporate office. This audit may cover such mechanical aspects as microscope alignment, resolution, and a field area determination. QC aspects such as the successful reading of a known reference slide and re-analysis of samples are also covered. The audit typically extends to document control, report generation and review, and data QA. Copies of these audits are maintained at the laboratory and at corporate headquarters, as applicable. It is the responsibility of the laboratory manager to notify the LC

and the QATS contractor of any issues identified during these internal QC audits that have the potential to impact data quality.

Site-Specific Procedures

Additional Site-specific QA/QC requirements for PCM have not been established.

4.1.1.3 Analytical Sensitivity

The analytical sensitivity that can be achieved in PCM analyses depends on sample volume and quantity of interfering dust. If lower sensitivity is required, the sample volume and collection time period can be increased. In accordance with the method, adjustments to sample volume and collection time should be selected so that the resulting filter has a structure density of between 100 to 1,300 structures per square millimeter (s/mm^2).

The PCM analytical sensitivity is calculated as:

$$S = EFA / (FOVs \cdot Afov \cdot V \cdot 1000 \cdot f)$$

where:

S = Sensitivity $(cc)^{-1}$

EFA = Effective filter area (square millimeters [mm^2])

FOVs = Number of fields of view examined

Afov = Area of a field of view (0.00785 mm^2)

V = Sample air volume (L)

1000 = cc/L (conversion factor; cubic centimeters per liter)

f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

For a direct preparation analysis of 100 FOVs for a sample with a total air volume of 100 liters, the resulting analytical sensitivity is about 0.005 cc^{-1}. Typically, analysis by PCM may stop after 100 FOVs have been examined or after 100 structures have been recorded (whichever occurs first).

As described in LB-000015, the filter overload rejection criteria for the project is 25% (i.e., if the particulate loading on a filter is visually observed to be greater than 25%, the sample will be deemed overloaded). When a sample filter is deemed to be overloaded, the filter is prepared using the indirect preparation procedures described in SOP EPA-Libby-08 and LB-000091. When an indirect preparation is required, the calculation of analytical sensitivity is modified to include a dilution factor (f). As a result, more FOVs will need to be examined during the PCM analysis of a filter prepared indirectly than one prepared directly to achieve the same analytical sensitivity.

4.1.1.4 Results Reporting

The results of PCM analyses are reported as the total number of countable PCM structures observed across all FOVs examined. Structure-specific attributes (e.g., length, width, structure type) are not reported. Air concentration is calculated as follows:

$$C = N * S$$

where:

C = Air concentration (s/cc)

N = Total number of countable PCM structures

S = Sensitivity $(cc)^{-1}$

4.1.2 Transmission Electron Microscopy (TEM)

TEM methods are more complex than PCM and PLM and require the use of a more sophisticated analytical instrument that operates at higher magnification (typically about 20,000x) and hence is able to detect structures much smaller than can be been seen by other methods. TEM methods can be used for air, dust, water, and solid media (e.g., soil, duff, tree bark, tissue).

When a sample is analyzed by TEM, the analyst records the size (length, width) and structure type (e.g., fiber, bundle) of each individual asbestos structure that is observed. This structure attribute information can be used to determine the number of PCM-equivalent[f] (or PCME) structures observed in the TEM analysis. This is important for the purposes of human health risk assessment because available toxicity values are based on studies utilizing PCM data.

The TEM analyst also records the mineral type of each individual asbestos structure that is observed. Mineral type is determined by energy dispersive spectrometry (EDS) and selected area electron diffraction (SAED):

- EDS is a method that takes advantage of the fact that an atom that is excited by absorbing a high energy electron will tend to re-emit the absorbed energy at a wavelength that is characteristic of the absorbing atom. Thus, when a particle is examined under a TEM instrument equipped with EDS, it is possible to obtain data on the atomic composition of each particle being examined. This makes it easy to distinguish organic fibers from mineral fibers, and also allows for distinguishing between different types of mineral fibers.

- SAED is a method based on the fact that crystalline structures diffract electrons to form a diffraction pattern that is characteristic of the underlying crystal structure. Thus, when a particle is examined under a TEM instrument equipped with SAED, it is possible to

[f] PCME definition: structure length greater than (>) 5 um, width greater than or equal to (≥) 0.25 um, and an aspect ratio ≥ 3:1 (NIOSH 1994).

obtain a diffraction pattern that is helpful in distinguishing organic from mineral fibers, and in classifying the nature of the mineral fiber.

There are many different standard methods that have been developed for TEM. These methods differ mainly in the recording rules that are utilized by the TEM analyst in reporting observed asbestos structures. At the Site, the most commonly used recording rules are those specified by the AHERA (see Section 4.1.2.3), ASTM 5755 (see Section 4.1.2.4), International Organization for Standardization (ISO) 10312:1995(E) (see Section 4.1.2.5), and EPA Method 100.2 (see Section 4.1.2.6).

4.1.2.1 Project-Specific SOPs and Method Modifications

The TEM methods used at the Libby Site have been updated by the following project-specific SOPs:

- EPA-LIBBY-08 – *Indirect Preparation for TEM Analysis* – This is a Site-specific SOP that provides standardized procedures for the indirect preparation of an air sample. These procedures were derived from the indirect preparation methods specified in ISO 13794 and ASTM D-5755.

- EPA-LIBBY-2012-11 – *Sampling and Analysis of Duff for Asbestos* – This is a Site-specific SOP that provides information for the sample preparation and analysis of duff materials.

- EPA-LIBBY-2012-12 – *Sampling and Analysis of Tree Bark for Asbestos* – This is a Site-specific SOP that provides information for the sample preparation and analysis of tree bark samples.

- EPA-LIBBY-2012-13 – *Analysis of Tissue for Asbestos* – This is a site-specific SOP that provides information for the preparation of tissue samples for TEM analysis.

The TEM methods have been further modified and clarified by the most current revisions of the following permanent project-specific laboratory modifications, which are available in the eRoom:

- LB-000016 – This modification applies to TEM structure recording rules for ISO 10312 and the documentation of previous historical modifications and clarifications. This modification applies to all Libby TEM samples where the ISO 10312 counting rules apply, regardless of sample matrix.

- LB-000020 - This modification applies to the treatment of all water samples with ozone/UV light and sonication prior to filtration as specified in Section 6.2 of EPA Method 100.1 (EPA 1983a).

- LB-000029 – This modification standardizes the TEM laboratory QC requirements, including the frequency of analysis, selection procedures, methods for interpretation of the results, and program acceptance criteria.

- LB-000031 – This modification applies to the TEM structure recording rules for air samples by AHERA and dust samples by ASTM D5755, and documentation of previous historical modifications and clarifications.

- LB-000040 – Specifies the use of ASTM Method D5755-09 for dust samples.
- LB-000055 - This modification applies to drying of air samples collected as part of the Outdoor Ambient Air Monitoring Programs and outdoor activity-based samples if wet sampling conditions are encountered.
- LB-000066 - This modification applies to the recording of the presence or absence of sodium and potassium, "close call" NAM particles, and probable mineral species (if known) for all investigative samples analyzed by TEM for the Libby Asbestos Site.
- LB-000067 – The modification describes three modifications applied to all TEM analyses: the use of ND (none detected) in place of NSD (no structures detected); inclusion of sketches for all asbestos structure (up to 50); and the use of the ISO 10312 structure identification rules for all TEM methodologies. It also provides direction for reporting laboratory blank analyses and specifying the appropriate preparation date for various media types.
- LB-000085 - The purpose of this modification is to standardize the frequencies and performance criteria of instrument calibrations at all TEM laboratories that analyze samples for the Libby Project.
- LB-000091 – The purpose of this modification is to describe modifications to the TEM Indirect preparation SOP (EPA-Libby-08).

4.1.2.2 QA/QC Procedures

General Procedures

Laboratory-based QA/QC for TEM is based on satisfactory performance covered by the requirements in the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP). This laboratory accreditation signifies the competency of a laboratory to provide testing services. The third-party accreditation complies with the standards published by ISO and the International Electro-technical Commission (IEC), specifically ISO/IEC 17025.

The NVLAP program reviews management and technical requirements pertaining to quality systems, personnel, facilities, test and calibration methods, equipment, measurement traceability, sampling, handling of test and calibration items, and reporting (NIST 2006a,b). Laboratories are required to pass TEM NVLAP accreditation every 2 years. In addition, TEM laboratories are required to participate in proficiency testing every 6 months. Unsatisfactory performance due to non-participation in regularly scheduled proficiency test rounds or unresolved technical nonconformities can subject a laboratory to denial or suspension of their accreditation and subsequent suspension on the Libby project. It is the responsibility of the TEM laboratory manager to provide current copies of NVLAP certifications to the LC for the contract files.

Site-Specific Procedures

In addition to the general QA/QC procedures described above, additional Site-specific requirements have also been established for TEM laboratory QC analyses. Libby laboratory modification LB-000029 provides guidelines to standardize the selection and evaluation procedures for TEM laboratory QC analyses. This modification also provides acceptance criteria and program-wide goals for TEM laboratory QC.

Table 4-1 summarizes the analysis frequency and acceptance criteria for each type of TEM laboratory QC analysis. *The investigation-specific QAPPs should specify the applicable analysis frequencies and acceptance criteria for TEM QC analyses*. Each type of TEM laboratory QC analysis is described in more detail below.

Laboratory Blanks – This is an analysis of TEM grids that are prepared from a new, unused filter that has been prepared and analyzed using same procedures as used for field samples. Laboratory blanks monitor overall laboratory cleanliness. There shall be no asbestos structures of any type detected in an analysis of 10 grid openings on any laboratory blank. If one or more asbestos structures are detected, the laboratory shall immediately investigate the source of the contamination and take immediate steps to eliminate the source of contamination before analysis of any investigative samples is resumed. Detection of any asbestos on laboratory blanks should be communicated to the LC immediately.

Drying Blanks – This is an analysis of TEM grids that are prepared from a new, unused filter that has accompanied the field samples through the oven-drying procedure (per LB-000055). Drying blanks monitor potential contamination due to the drying process. There shall be no asbestos structures of any type detected in an analysis of 10 grid openings on any drying blank. If one or more asbestos structures are detected, the laboratory shall immediately investigate the source of the contamination and take immediate steps to eliminate the source of contamination before analysis of any investigative samples is started. Detection of any asbestos on drying blanks should be communicated to the LC immediately.

Recounts – Recount analyses include recount same, recount different, inter-laboratory analyses, and verified analyses. In all cases, the analysis is a re-examination (or recount) of the original TEM grid openings that were evaluated in the initial analysis. Each of these recount analyses are described in more detail below:

- *Recount Same* – This is an analysis in which the original TEM grid openings are re-examined by the same microscopist who performed the initial examination.
- *Recount Different* – This is an analysis in which the original TEM grid openings are re-examined by a different microscopist in the same laboratory than who performed the initial examination.
- *Inter-laboratory* – This is an analysis in which a previously analyzed sample is re-prepared by the original laboratory and the original TEM grid openings are re-examined by a microscopist in a different laboratory than who performed the initial examination.
- *Verified Analysis* – This analysis is similar to a Recount Different but has more detailed requirements with regard to documentation. A verified analysis must be recorded in accordance with the protocol provided in NIST (1994).

LB-000029 specifies how each type of recount analysis is to be selected. In brief, samples for recount same, recount different, and verified analyses are to be selected and evaluated by the TEM laboratory at the time of analysis, preferentially selecting grid openings with structures observed. It is the responsibility of the analytical laboratory QAM to ensure that the proper number and types of recount analyses are performed.

Inter-laboratory analyses will be selected *post hoc* by the QATS contractor or their designate. The list of samples selected for inter-laboratory analysis will be provided to the LC, who will coordinate with the analytical laboratories to ensure that selected samples are prepared and analyzed in accordance with the inter-laboratory procedures in LB-000029.

Recount analyses are evaluated on a grid opening- and structure-specific basis to determine if structure results meet the following acceptance criteria:

Measurement parameter	Concordance Rule
Number of LA asbestos structures within each grid opening	For grid openings with 10 or fewer structures, counts must match exactly. For grid openings with more than 10 structures, counts must be within 10 percent (%) as calculated by RPD (((maximum count – minimum count)/average count)*100%).
Asbestos class of structure	Must agree 100% on chrysotile vs. amphibole. For assignment of amphiboles to LA or OA bins, must agree on at least 90% of all amphibole structures.
LA Structure length	For fibers and bundles, must agree within 1 micron (µm) or 10% (whichever is less stringent). For clusters and matrices, must agree within 2 µm or 20% (whichever is less stringent).
LA Structure width	For fibers and bundles, must agree within 0.5 µm or 20% (whichever is less stringent). For clusters and matrices, there is no quantitative rule for concordance.
Presence of Sodium (Na) and Potassium (K)	There is no rule for concordance, but must be tabulated to identify potential trends that may indicate inconsistencies in recording practices or interpretation of spectra.

Whenever a recount occurs in which the acceptance criteria are not met, the sample will undergo verified analysis as described by NIST (1994), and the senior laboratory analyst will use the results of the validated analysis to determine the basis of the discordance, and take appropriate corrective action (e.g., re-training in counting rules, quantification of size, identification of types, etc). Whichever analytical result is determined to be correct will be identified with the word "Confirmed" in the sample comment field of the EDD[g]. In the special case where the original and the recount analysis are both determined to have one or more areas of discordance, a third analysis will be prepared that contains the correct results. This analysis will be identified as a "Reconciliation" EDD. The laboratory will maintain records of all cases of discordant results and of actions taken to address any problems, in accordance with NVLAP

[g] Recount results should be used to provide general information on data quality for the purposes of the data usability assessment. Data users should not utilize recount or reconciliation results to alter original results.

requirements. In addition, the laboratory manager should notify the LC of any significant exceptions and corrective actions through a laboratory ROM (see Section 4.6.3).

Results for inter-laboratory analyses are evaluated by the laboratory performing the inter-laboratory analysis using the same criteria specified above, with any areas of discordance noted, discussed with the originating laboratory, and the appropriate action taken (i.e., re-training). Laboratories notify the LC if inter-laboratory analyses do not meet acceptance criteria and if corrective action(s) is needed.

Repreparations – This is an analysis of TEM grids that are prepared from a new aliquot of the same field filter as was used to prepare the original grids. Typically, this is done within the same laboratory that performed the original analysis, but a different laboratory may also prepare grids from a new piece of the filter. If the re-preparation is done within the same laboratory, the re-preparation and re-analysis are done by a different analyst than who performed the original analysis, whenever possible. LB-000029 specifies how re-preparation analyses are to be selected. In brief, samples for re-preparation are to be selected by the analytical laboratory at the time of analysis, preferentially selecting samples with one or more structures recorded.

Re-preparation samples will be evaluated by the analytical laboratory by comparing the results for the original and the re-preparation analyses. In order to be ranked as concordant, the results must not be statistically different from each other at the 90% confidence interval, as evaluated using the Poisson ratio test[h] (Nelson 1982). If the re-preparation results are found to be statistically different from the original analysis results, a senior analyst will investigate to see if this discordance may be related to laboratory procedures, and will take appropriate corrective action (e.g., re-training in sample and filter preparation, counting rules, quantification of size, identification of types, etc).

Performance Evaluation Standards – At this time, there are no PE standards available to assess the accuracy of TEM analysis of asbestos fibers on filters. However, Research Triangle Institute is in the process of developing a chamber that can be used to load various types of asbestos to multiple filters at the same time at a standard nominal loading level (i.e., s/mm^2). If this chamber can be used to load filters with nominal levels of LA, these filters could be used as part of the TEM QA/QC program for the Libby laboratories to evaluate laboratory performance. This QARD will be updated to provide details on such a program in the future as appropriate.

The overall program-wide assessment criteria for TEM laboratory QC analyses are as follows:

QC Type	Metric	Program-Wide Criteria		
		Good	Acceptable	Poor
Blanks	% with ≥ 1 asbestos structures	0% - 0.1%	0.2% - 0.5%	>0.5%
Recounts	Concordance on LA count	>95%	85-95%	<85%
	Concordance on type (chrysotile vs. amphibole)	>99%	95%-99%	<95%
	Concordance on LA length	>90%	80%-90%	<80%

[h] LB-000029 includes an Excel spreadsheet tool that can be used by the laboratory staff to make this statistical comparison.

QC Type	Metric	Program-Wide Criteria		
		Good	Acceptable	Poor
	Concordance on LA width	>90%	80%-90%	<80%
Repreparations	Concordance on LA concentration	>95%	90-95%	<90%

These metrics will be tracked temporally for each laboratory by the QATS contractor to identify potential trends. If TEM laboratory QC results are ranked as good, no action is necessary. If results are ranked as acceptable, no action is necessary, unless temporal trends indicate an issue within a single laboratory. In this case, the QATS contractor will coordinate with the laboratory QAM to investigate potential reasons for concordance issues. If TEM laboratory QC results are ranked as poor, the QATS contractor shall investigate and may request corrective action, as necessary.

4.1.2.3 AHERA

This TEM method is based on regulations established for evaluating asbestos risks in schools under the Asbestos Hazard Emergency Response Act (AHERA), *Appendix A to Subpart E of 40 CFR Part 763, EPA's Interim Transmission Electron Microscopy Analytical Methods C Mandatory and Nonmandatory C and Mandatory Section to Determine Completion of Response Actions*. Structure recording rules for AHERA differ from other recording rules (i.e., ISO 10312, EPA Method 100.2) in that no attempt is made to record individual fibers that are part of a larger matrix or cluster aggregate. As a consequence, a sample analyzed using AHERA recording rules may report a lower structure count than if it were analyzed using ISO 10312 recording rules.

Under AHERA recording rules, a fiber is defined as any structure ≥ 0.5 µm that has substantially parallel sides and an aspect ratio ≥ 5:1. At the Site, this aspect ratio rule has varied over time (refer to the current version of LB-000031), with more recent samples analyzed using an aspect ratio rule of ≥ 3:1, which allows for the estimation of PCME structures.

At the Site, AHERA is typically used as the analysis method for outdoor perimeter sample monitoring during soil removal activities and for indoor clearance samples collected following interior removal activities. On occasion, AHERA is used as a secondary analysis method for worker H&S samples to quantify air concentrations of asbestos in samples that approach or exceed OSHA exposure limits.

Project-Specific SOPs and Method Modifications

The AHERA method has been further modified and clarified for use at the Site by the most recent revision of permanent project-specific laboratory modifications LB-000031 (see Section 4.1.2.1).

Analytical Sensitivity

The analytical sensitivity for AHERA analyses of air samples is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

S = Sensitivity $(cc)^{-1}$

EFA = Effective filter area (square millimeters [mm^2])

GOx = Number of grid openings examined

Ago = Area of a grid opening (about 0.01 mm^2)

V = Sample air volume (L)

1000 = cc/L (conversion factor in cubic centimeters per liter)

f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

When a sample filter is deemed to be overloaded, the filter may be prepared using an indirect preparation method in accordance with SOP EPA-LIBBY-08 and LB-000091. There are two indirect preparation methods specified in SOP EPA-LIBBY-08: with and without ashing of the original filter. The ashing step helps to remove organic material that may be present on the filter. *The investigation-specific QAPPs will specify if the indirect preparation technique should include ashing.* If ashing is not required, a portion of the original filter is suspended in water, and an aliquot of the water suspension is placed onto a second filter. If ashing is required, the original filter is ashed and the resulting residue is suspended in water, and an aliquot of the water suspension is placed onto a second filter. When an indirect preparation is required, the calculation of analytical sensitivity is modified to include a dilution factor (f). As a result, more grid openings will need to be examined during the analysis of a filter prepared indirectly than one prepared directly to achieve the same analytical sensitivity.

As with all asbestos air analysis methods, the analytical sensitivity can be improved (decreased) by increasing the sampling flow rate or sample collection duration. In accordance with the AHERA method, air flow rates should be between 1 and 10 L/min. *The investigation-specific QAPPs will specify the target analytical sensitivity for AHERA analyses.* Typically, the target analytical sensitivity for AHERA analyses is 0.005 cc^{-1} (per the requirements specified in AHERA).

Results Reporting

The results of a TEM analysis report the total number of countable structures observed across all grid openings examined. In addition, because structure-specific attributes (e.g., length, width, structure type) are recorded, the number of structures that meet other "binning" categories, such as number of PCME structures, can also be reported. Air concentration is calculated from the number of structures (for the desired binning category) as follows:

$$C_i = N_i * S$$

where:

C_i = Air concentration for binning category 'i' (s/cc)

N_i = Number of countable structures for binning category 'i'

S = Sensitivity $(cc)^{-1}$

The Libby-specific TEM laboratory data reporting tools (see Section 4.6.2) are designed to automatically compute analytical sensitivity and air concentration values.

4.1.2.4 ASTM 5755

Method Description

The ASTM originally released their dust method D 5755, *Standard Test Method for Microvacuum Sampling and Indirect Analysis for Dust by TEM for Asbestos Structure Number Concentrations*, in August 1995. Since that time, ASTM has reissued this method three times (in 2002, 2003, and 2009). The current method version is ASTM D 5755-09.

As noted previously (see Section 3.1.2), dust samples are no longer routinely collected at the Site. However, in some cases, previously collected dust samples that are in archive are analyzed in support of GPI and cleanup design.

In brief, the ASTM 5755 method provides a standardized procedure to identify asbestos in dust and estimate the surface loading of asbestos in the sampled dust, reported as the number of asbestos structures per unit area of the sampled surface (e.g., s/cm^2). The procedure specifies an indirect filter preparation technique, which is intended to disperse aggregated asbestos into fundamental fibrils, fiber bundles, clusters, or matrices that can be more accurately quantified by TEM. Due to the use of an indirect sample preparation technique, the asbestos observed for quantification may not represent the physical form of the asbestos as sampled. Dust samples analyzed in accordance with ASTM 5755 utilize AHERA structure recording rules (see Section 4.1.2.3).

Project-Specific SOPs and Method Modifications

The ASTM 5755 method has been updated by the following project-specific SOP:

- SRC-LIBBY-05 – *Collection and Analysis of Asbestos in Indoor Dust* – This SOP standardizes the sample collection approach of indoor dust samples and the reporting of results following dust analysis using the project-amended ASTM D5755 method.

The ASTM 5755 method has been further modified and clarified by the most recent revisions of permanent project-specific laboratory modifications LB-000031 and LB-000040 (see Section 4.1.2.1).

Analytical Sensitivity

The TEM analytical sensitivity for dust samples is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot SA \cdot f)$$

where:

S = Sensitivity $(cm)^{-2}$

EFA = Effective filter area (mm^2)

GOx = Number of grid openings examined

Ago = Area of a grid opening (about 0.01 mm^2)

SA = Sample area (cm^2)

f = Indirect preparation dilution factor

As noted above, all dust samples analyzed in accordance with ASTM 5755 are prepared using indirect preparation methods. During indirect preparation, a portion of the original filter is suspended in water, and an aliquot of the water suspension is placed onto a second filter. The calculation of analytical sensitivity includes a factor (f) to account for the amount of dilution necessary to achieve optimum loading on the second filter.

In accordance with SOP SRC-LIBBY-05, the target analytical sensitivity should be 500 cm^{-2} (with a maximum of 1,000 cm^{-2}), *unless otherwise specified in the investigation-specific QAPP.* The analytical sensitivity can be adjusted by selecting an appropriate combination of the sampling and analysis parameters described in the above equation. For example, if lower analytical sensitivity is required, the sample area or number of GOs examined may be increased.

Results Reporting

The results of an ASTM 5755 analysis report the total number of countable structures observed across all grid openings examined. In addition, structure-specific attributes (e.g., length, width, structure type) are also reported. Dust loading is calculated from the total number of structures observed as follows:

$$L = N * S$$

where:

L = Dust loading (s/cm^2)

N = Total number of countable structures

S = Sensitivity (cm^{-2})

The Libby-specific TEM laboratory data reporting tools (see Section 4.6.2) are designed to automatically compute analytical sensitivity and loading values.

4.1.2.5 ISO 10312:1995(E)

The ISO 10312:1995(E) method, *Ambient air – Determination of Asbestos fibers – Direct-transfer Transmission Electron Microscopy Method* was issued in 1995. This TEM method is suitable for use in determining the concentration of asbestos structures in both indoor and outdoor environments. ISO 10312 structure recording rules differ from other TEM analysis methods (i.e., AHERA) in that there is a fairly complex set of rules for counting fibers that occur in higher order structures (e.g., matrices, clusters), tending to enumerate individual fibers when they can

be clearly distinguished, and counting the higher order particles as a unit when the individual fibers cannot be clearly resolved.

Under ISO 10312 recording rules, a fiber is defined as any structure ≥ 0.5 µm that has substantially parallel sides and an aspect ratio ≥ 5:1. At the Site, this aspect ratio rule has varied over time (see LB-000016), with more recent samples analyzed using an aspect ratio rule of ≥ 3:1, which allows for the estimation of PCME structures.

At the Site, ISO 10312 is typically used as the principle recording method for investigative samples (e.g., activity-based sampling [ABS], ambient air monitoring). Although ISO 10312 is written as an analytical method for air filters that are directly prepared, at the Site, ISO 10312 has also been utilized to specify the desired recording rules for air samples that have been prepared indirectly (per SOP EPA-LIBBY-08 and LB-000091) and for the TEM analysis of other non-air media, such as dust, tree bark, duff, soil, water, and tissue.

When ISO 10312 is applied to non-air media, the filter is usually prepared in the TEM laboratory from the sampled media (e.g., duff, tree bark, tissue). Once the sampled medium is placed onto a filter, there is effectively no difference between various media in structure recording requirements (i.e., the TEM ISO 10312 recording rules are similar regardless of the medium). *The investigation-specific QAPPs will include specific details on the preparation, analysis, and reporting requirements for samples evaluated using TEM ISO 10312 recording rules.*

Project-Specific SOPs and Method Modifications

The ISO 10312 method has been further modified and clarified for use at the Libby Site by the most recent revisions of permanent project-specific laboratory modifications LB-000016 and LB-000055 (see Section 4.1.2.1).

Analytical Sensitivity and Results Reporting

The investigation-specific QAPPs will specify the target analytical sensitivity and TEM analysis requirements to achieve DQOs. The following sections summarize the methods for calculating analytical sensitivity and reporting results for each type of medium that can be analyzed using ISO 10312 recording rules. The Libby-specific TEM laboratory data reporting tools (see Section 4.6.2) are designed to automatically compute analytical sensitivity and concentration or loading values.

Air

The analytical sensitivity and results reporting for ISO 10312 analyses of air samples is calculated in the same manner as described above for AHERA. As noted previously, the analytical sensitivity can be improved (decreased) by increasing the sampling flow rate or sample collection duration. Flow rates and sampling durations should be chosen using the highest flow rate and longest duration possible without overloading the filter. Flow rates should not exceed 15 L/min, as this can result in damage to the sample filter. Flow rates should not be less than 1 L/min, because this would result in linear velocities below those required for analysis by ISO 10312.

Dust

The analytical sensitivity and results reporting for ISO 10312 analyses of dust samples is calculated in the same manner as described above for ASTM 5755.

Tree Bark

All tree bark samples analyzed in accordance with Site-specific SOP EPA-LIBBY-2012-12 are prepared by the TEM laboratory using preparation methods as described in the SOP, which include sample ashing, acid treatment, and indirect preparation of the resulting residue. During preparation, an aliquot of the ashed/acidified tree bark residue is suspended in water, and an aliquot of the water suspension is placed onto a filter. The calculation of analytical sensitivity includes a factor (f) to account for the amount of residue dilution necessary to achieve optimum loading on the filter. If the analytical summary or COC specifies for the preparation and analysis of multiple filter replicates for each tree bark sample, the resulting filters should be analyzed and the results reported separately for each filter.

This filter is then examined by TEM and observed structures are recorded in accordance with ISO 10312 recording rules.

For tree bark, the TEM analytical sensitivity is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot SA \cdot f)$$

where:

S = Sensitivity $(cm)^{-2}$

EFA = Effective filter area (about 1295 mm^2)

GOx = Number of grid openings examined

Ago = Area of a grid opening (about 0.01 mm^2)

SA = Sample area (cm^2)

f = Indirect preparation dilution factor

In accordance with SOP EPA-LIBBY-2012-12, the target analytical sensitivity should not be higher than 100,000 cm^{-2}, *unless specified otherwise in the investigation-specific QAPP*. The analytical sensitivity can be adjusted by selecting an appropriate combination of the sampling and analysis parameters described in the above equation. For example, if a better analytical sensitivity is required, the number of GOs examined may be increased.

The results of a tree bark sample analysis report the total number of countable structures observed across all grid openings examined. Structure loading on the bark surface is calculated from the total number of structures observed as follows:

$$L = N * S$$

where:

L = Surface loading (s/cm^2)

N = Total number of countable structures

S = Sensitivity $(cm)^{-2}$

Duff

All duff samples analyzed in accordance with Site-specific SOP EPA-LIBBY-2012-11 are prepared by the TEM laboratory using preparation methods as described in the SOP, which include sample ashing, acid treatment, and indirect preparation of the resulting residue. During preparation, an aliquot of the ashed/acidified duff residue is suspended in water, and an aliquot of the water suspension is placed onto a filter. The calculation of analytical sensitivity includes a factor (f) to account for the amount of residue dilution necessary to achieve optimum loading on the filter. This filter is then examined by TEM and observed structures are recorded in accordance with ISO 10312 recording rules. If the analytical summary or COC specifies for the preparation and analysis of multiple filter replicates for each duff sample, the resulting filters should be analyzed and the results reported separately for each filter.

For duff, the TEM analytical sensitivity is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot M \cdot f)$$

where:

S = Sensitivity $(g, dry\ weight)^{-1}$

EFA = Effective filter area (about 1295 mm^2)

GOx = Number of grid openings examined

Ago = Area of a grid opening (about 0.01 mm^2)

M = Sample mass (g, dry weight)

f = Indirect preparation dilution factor

In accordance with SOP EPA-LIBBY-2012-11, the default target analytical sensitivity should be 1E+07 g^{-1}, *unless specified otherwise in the investigation-specific QAPP.* The analytical sensitivity can be adjusted by selecting an appropriate combination of the sampling and analysis parameters described in the above equation. For example, if a better analytical sensitivity is required, the sample mass may be increased and/or the number of GOs examined may be increased.

The results of a duff sample analysis report the total number of countable structures observed across all grid openings examined. In addition, structure-specific attributes (e.g., length, width) are also reported. Thus, it is possible to express reported concentrations either as asbestos structures per gram of duff material (s/g) or as an estimated mass percent (on a dry weight

basis). Concentration, expressed as s/g, is calculated from the total number of structures observed as follows:

$$C = N * S$$

where:

C = Concentration (s/g, dry weight)

N = Total number of countable structures

S = Sensitivity (g, dry weight)$^{-1}$

In order to express concentration as mass percent, the mass of each asbestos structure observed is estimated from its dimensions. In the absence of detailed data on the true geometry of each particle, the mass is roughly approximated by assuming a simple rectangular solid shape and a default asbestos density (g/cm^3). Because estimates of mass percent are uncertain as a consequence of the calculation approach, reporting duff concentrations as s/g is preferred. *The investigation-specific QAPPs will specify the results reporting requirements for duff analyzed by TEM.*

Soil

For soil samples that are prepared using a fluidized bed asbestos segregator (FBAS) in accordance with the method procedures specified in SOP ESAT-LIBBY-01, air is passed through an aliquot of the soil sample and particles that are elutriated from the soil are deposited onto a filter that is then examined by TEM. If an indirect preparation of this filter is necessary, the calculation of analytical sensitivity will include a factor (f) to account for any necessary dilutions.

For soil samples prepared by FBAS, the TEM analytical sensitivity is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot M \cdot Q_R \cdot f)$$

where:

S = Sensitivity (g, dry weight)$^{-1}$

EFA = Effective filter area (mm^2)

GOx = Number of grid openings examined

Ago = Area of a grid opening (about 0.01 mm^2)

M = FBAS soil sample mass (g, dry weight)

Q_R = FBAS flow ratio

f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

The analytical sensitivity can be adjusted by selecting an appropriate combination of the sampling and analysis parameters described in the above equation. For example, if a better

analytical sensitivity is required, the sample mass may be increased and/or the number of GOs examined may be increased.

Similar to duff, the results of a soil sample analysis report the total number of countable structures observed across all grid openings examined, as well as structure-specific attributes (e.g., length, width). Thus, it is possible to express reported concentrations either as asbestos structures per gram of soil (s/g) or as an estimated mass percent using the same calculation methods as described above for duff. However, the TEM analyses of soil PE standards for LA following preparation by FBAS have shown that estimates of mass percent should not be utilized directly as they tend to be biased low. Thus, if estimates of mass percent are required, they should be derived from LA-specific calibration curves. The derivation of these calibration curves is currently in development.

4.1.2.6 EPA Method 100.2

EPA Method 100.2, *Determination of Asbestos Structures over 10 m in Length in Drinking Water*, is used when preparing water samples for analysis by TEM. Although water samples are prepared by EPA Method 100.2, they are analyzed by ISO Method 10312.

In accordance with the method, if the collected water is not filtered within 48 hours, samples must undergo special preparation methods[i] to address bacterial and algal growth that can influence the reporting of structures in the TEM analysis. In brief, sample preparation includes an ozonation/ultraviolet light treatment and sonication step, which is designed to oxidize organic matter present in the water or on the walls of the bottle, thus destroying any material that might cause clumping and binding of asbestos structures. *The investigation-specific QAPP will specify the required preparation methods for water samples.*

Project-Specific SOPs and Method Modifications

EPA Method 100.2 has been further modified and clarified by the most recent revision of permanent project-specific laboratory modification LB-000020 (see Section 4.1.2.1). This modification requires that the treatment of all water samples with ozone/UV prior to filtration (regardless of whether the sample is filtered within 48 hours).

Analytical Sensitivity

The analytical sensitivity for TEM analyses of water samples is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot V)$$

where:

S = Sensitivity $(L)^{-1}$

EFA = Effective filter area (mm^2)

GOx = Number of grid openings examined

[i] See Section 6.2 of EPA Method 100.1 or Attachment 1 of EPA Method 100.2.

Ago = Area of a grid opening (about 0.01 mm^2)

V = Water volume applied to the filter (L)

For water analyses, the analytical sensitivity can be improved (decreased) by increasing the volume applied to the filter and/or by increasing the number of grid openings examined. In accordance with EPA Method 100.2, the target analytical sensitivity should not exceed 200,000 L^{-1}, *unless specified otherwise in the investigation-specific QAPP.*

Results Reporting

The results of a water analysis by TEM report the total number of countable structures observed across all grid openings examined. In addition, because structure-specific attributes (e.g., length, width) are recorded, the number of structures that meet other "binning" categories, such as the number of structures longer than 10 µm, can also be reported. Water concentration is calculated from the number of structures (for the desired binning category) as follows:

$$C_i = N_i * S$$

where:

C_i = Water concentration for binning category 'i' (s/L)

N_i = Number of countable structures for binning category 'i'

S = Sensitivity $(L)^{-1}$

Water concentrations are frequently reported in units of million fibers per liter, or MFL, which can be calculated from concentrations reported as s/L by multiplying by 1E-06.

The Libby-specific TEM laboratory data reporting tools (see Section 4.6.2) are designed to automatically compute analytical sensitivity and water concentration values.

4.1.3 Polarized Light Microscopy (PLM)

The PLM method capitalizes on the fact that light passing through a translucent mineral will interact with the internal crystal structure of the mineral grains, and the transmitted light (that which passes through the particle) tends to be polarized, having a higher intensity in some orientations than in others. Because this effect depends on the composition and/or structure of the particle, each mineral has a unique effect on light passing through it. Thus, based on the optical properties (e.g., refractive index, birefringence, color) of the particle, it is possible to distinguish asbestos from non-asbestos, and to classify different types of asbestos.

PLM is not applicable to samples that may contain many fine fibers below the resolution of the light microscope (e.g., air samples). For this reason PLM is only applied to bulk samples of soil or construction materials, where many of the fibers can be expected to be fairly large.

At the Site, there are two different PLM methods that are utilized to analyze soil and other bulk materials – PLM NIOSH 9002 (described in Section 4.1.3.1) and the Libby-specific PLM method (described in Section 4.1.3.2).

4.1.3.1 NIOSH 9002

NIOSH Method 9002-Issue 2, *Asbestos (Bulk) by PLM,* was issued in 1994. In this method, the PLM analyst utilizes visual estimation techniques (e.g., standard area projections, photographs, drawings, or trained experience) to determine the asbestos content of bulk materials (e.g., soil, insulation). Results are reported qualitatively for levels below 1%, either as non-detect (ND) when no asbestos is observed, or as "<1%" when asbestos is present but at levels lower than 1%. Results above 1% are reported quantitatively (usually to the nearest whole percent based on area estimation).

At the Site, NIOSH Method 9002 is principally used as a screening tool for rapid turn-around PLM analysis of unprocessed soil samples collected during response actions and restoration activities.

QA/QC Procedures

General Procedures

Laboratory-based QA/QC for PLM is maintained by following the requirements specified in NIOSH Method 9002 and through satisfactory completion of the requirements specified by NVLAP for PLM. Laboratories are required to pass PLM NVLAP accreditation every 2 years. In addition, PLM laboratories are required to participate in proficiency testing every 6 months. Unsatisfactory performance due to non-participation in regularly scheduled proficiency test rounds or unresolved technical nonconformities can subject a laboratory to denial or suspension of their accreditation and subsequent suspension on the Libby project. It is the responsibility of the PLM laboratory manager to provide current copies of NVLAP certifications to the LC for the contract files.

NVLAP requirements include monthly checks of the refractive index liquids, daily microscope adjustments, USGS standards, and evaluations of various blanks to check for contamination. Overall QC analysis should be at a rate of at least 10%, including inter- and intra-analyst laboratory duplicates, laboratory blanks, and inter-laboratory analyses. It is the responsibility of the laboratory QAM to ensure that these QA/QC assessments are conducted at the specified frequency and that results are recorded in the laboratory logbooks. Copies of all QA/QC assessment results are submitted directly to the LC by the laboratory manager. Results for laboratory QC analyses should also be included (and clearly identified as QC) in the electronic deliverable for each laboratory job. It is the responsibility of the LC to notify the QATS contractor of any issues identified during these QA/QC assessments.

Site-specific Procedures

Additional Site-specific QA/QC requirements for NIOSH Method 9002 have not been established.

Project-Specific Method Modifications

NIOSH Method 9002 has been further modified and clarified by the most recent revisions of the following permanent project-specific laboratory modifications.

- LB-000087 – Clarifies that the "Act/Trem" classification reported by NIOSH Method 9002 is LA, based on site knowledge. The mod also discusses the historical reporting of results, and provides direction to the laboratories to record and report results as "Act/Trem" in accordance with NIOSH Method 9002.

4.1.3.2 Libby-Specific PLM

At the Site, soil samples for analysis by the Libby-specific PLM methods are first processed in accordance with SOP ISSI-LIBBY-01 (see Section 5 for detailed on the soil processing facility). In brief, each soil sample is dried and sieved through a ¼-inch screen. Particles retained on the screen (if any) are referred to as the "coarse" fraction. Particles passing through the screen are referred to as the fine fraction, and this fraction is ground by passing it through a plate grinder. The resulting material is referred to as the "fine ground" fraction. The fine ground fraction is split into four equal aliquots; one aliquot is submitted for analysis and the remaining three aliquots are archived.

The coarse fractions are examined in accordance with SOP SRC-LIBBY-01, referred to as "PLM-GRAV". SRC-LIBBY-01, *Qualitative Estimation of Asbestos in Coarse Soil by Visual Examination Using Stereomicroscopy and Polarized Light Microscopy (PLM)*, was developed in 2002 and contains elements from NIOSH Method 9002 and EPA Method 600/R-93/116. PLM-GRAV provides a screening method to examine the coarse soil fraction for evidence of asbestos mineral content using stereomicroscopy with confirmation of asbestos by PLM. The method is suitable for use on soil and other soil-like media (e.g., sediment) to quantify all types of asbestos fibers, including chrysotile and amphiboles (like those characteristic of the Libby site). The method sensitivity can be affected by the homogeneity of the sample, the accuracy of the weight measurements obtained at the laboratory, and the effectiveness of the sample reduction and filtering procedures.

The fine ground aliquots are examined using visual area estimation in accordance with SOP SRC-LIBBY-03, referred to as "PLM-VE". SRC-LIBBY-03 *Analysis of Asbestos Fibers in Soil by PLM,* was developed in 2003 and is based on NIOSH 9002 Issue 2, EPA Method 600/R-93/116, and California Air Resources Board (CARB) Method 435. PLM-VE is a semi-quantitative method that utilizes LA-specific reference materials to allow assignment of fine ground samples into one of four reporting "bins", as follows:

- Bin A (ND): non-detect
- Bin B1 (Trace): detected at levels lower than the 0.2% (by mass) LA reference material
- Bin B2 (<1%): detected at levels lower than the 1% (by mass) LA reference material but greater than or equal to the 0.2% LA reference material
- Bin C: LA detected at levels greater than or equal to the 1% LA reference material; results are reported to the nearest whole percent

The Libby-specific PLM-VE laboratory data reporting tool (see Section 4.6.2) is designed to automatically assign the appropriate bin based on the analyst input.

Sample results for PLM-GRAV and PLM-VE analyses may be combined using a mass-weighted averaging approach, as discussed in Libby *Technical Memo 8* (EPA 2008a).

Project-Specific Method Modifications

The Libby-specific PLM methods have been further modified and clarified by the most recent revisions of the following permanent project-specific laboratory modifications:

- LB-000073 - The purpose of this modification is to provide permanent clarifications to inter-laboratory analyses for the Libby-specific PLM-VE (SRC-LIBBY-03) and PLM-GRAV (SRC-LIBBY-01) methods. This modification standardizes the selection and analysis procedures for inter-laboratory soil samples.
- LB-000088 – Documents the effective dates of SOPs SRC-LIBBY-01 (Rev. 3) and SRC-LIBBY-03 (Rev. 3).
- LB-000097 – The purpose of this modification is to standardize, to the extent possible, the slide preparation procedures, and also create a new QC analysis type (LDCR), which will be a re-preparation and analysis by a different analyst within the same laboratory.
- LB-000098- Provided clarification to the procedures for the preparation and analysis of LDC and LDS QC analyses.

Method-Specific QA/QC Procedures

Laboratory QA/QC for PLM-GRAV is ensured through compliance with laboratory-based QA/QC requirements for the NIOSH Method 9002, as specified by NVLAP. No additional project-specific QA/QC requirements have been established for PLM-GRAV.

With the exception of inter-laboratory analysis QC requirements, which can be found in the most recent revision of LB-000073, all laboratory-based QA/QC requirements for PLM-VE are specified in SOP SRC-LIBBY-03. **Table 4-1** summarizes the analysis frequency and acceptance criteria for each type of PLM-VE laboratory QC analysis. *Unless specified otherwise in the investigation-specific QAPPs,* the PLM-VE QC analyses specified in **Table 4-1** are required.

Three types of laboratory-based QC analyses are performed for PLM-VE, including laboratory duplicates, inter-laboratory analyses, and PE standards. Each of type of QC sample is discussed in more detail below.

Laboratory Duplicates – There are three types of laboratory duplicates. A re-preparation of a soil sample slide by the same analyst is referred to as a "Laboratory Duplicate Self-check" [LDS], the reanalysis of a soil sample slide by a different analyst is referred to as a "Laboratory Duplicate Cross-check" [LDC], and the re-preparation and analysis of a sample by a different analysts is referred to as a "Laboratory Duplicate Cross-check Re-prep"[LDCR]. The overall QC analysis rate for laboratory duplicates is 10%; 2% for the LDS, 4% for the LDC, and 4% for the LDCR. It is the responsibility of the analytical laboratory QAM to ensure that the proper number and types of laboratory duplicates are performed.

When evaluating results for laboratory duplicates, results are ranked as concordant if both the original sample result and the laboratory duplicate result report the same semi-quantitative "bin". Results are ranked as weakly discordant if the original sample result and the laboratory duplicate result differ by one semi-quantitative bin (i.e., Bin A vs. Bin B1). Results are ranked as strongly discordant if the original sample result and the laboratory duplicate result differ by

more than one semi-quantitative bin (i.e., Bin A vs. Bin B2). As specified in SOP SRC-LIBBY-03, laboratory duplicate results are deemed "acceptable" if results are within one bin (i.e., are not strongly discordant). The laboratory manager should notify the LC if laboratory duplicates do not meet acceptance criteria and corrective action(s) must be taken immediately. Examples of corrective actions that may be taken are reanalysis and/or re-preparation the sample, and analyst re-training.

Inter-Laboratory Analyses – An inter-laboratory analysis is an examination of a second fine ground aliquot of the same soil sample by a PLM analyst at a different laboratory than completed the original analysis.

As specified in LB-000073, the minimum frequency for the analysis of inter-laboratory analyses is 1%. Samples for inter-laboratory analysis will be selected *post hoc* by the QATS contractor (or their designate) on a quarterly basis in accordance with the selection procedures in LB-000073. The list of selected samples will then be provided to the LC. The LC will direct the Troy SPF which samples should have a second fine ground aliquot inserted into the sample train, and to which PLM laboratory the sample should be sent. Inter-laboratory samples are blind to the PLM laboratory (i.e., the laboratory is not able to determine authentic field samples from inter-laboratory samples). In order to be identified as inter-laboratory analyses in the database, the laboratory QC type is changed from "NOT QC" to "Inter-laboratory Analysis" prior to upload.

Results for inter-laboratory analyses are evaluated by the QATS contractor or their designate using the same concordance ranking method described above for laboratory duplicates. Corrective action(s) must be taken if inter-laboratory analyses do not meet acceptance criteria. Examples of corrective actions that may be taken include reanalysis and/or re-preparation, collaboration between and among laboratories to address between laboratory differences, and analyst re-training. The QATS contractor will notify the LC if inter-laboratory analyses do not meet acceptance criteria and if corrective action is needed.

The overall program-wide assessment criteria for inter-laboratory analyses are as follows:

Metric	Program-Wide Assessment		
	Good	Acceptable	Poor
% pairs ranked as strongly discordant	<5%	5-10%	>10%
% pairs ranked as weakly discordant	<20%	20-40%	>40%

The inter-laboratory concordance metrics should be tracked temporally for each laboratory to identify potential trends in weak and/or strong discordance. If inter-laboratory results are ranked as good, no action is necessary. If inter-laboratory results are ranked as "Acceptable", the QATS contractor will investigate potential reasons for discordant results and may request corrective action(s), in consultation with EPA, such as re-training of laboratory analysts, increasing the frequency of inter-laboratory analyses, and/or performance evaluation analyses for the laboratory in question. If the inter-laboratory results are ranked as "Poor", the QATS contractor will investigate potential reasons for discordant results and may request corrective action(s), in consultation with EPA. Corrective action may include conducting a laboratory audit, re-training of laboratory analysts, performing a focused inter-laboratory assessment

specific to that laboratory until proficiency can be demonstrated, and performing a reanalysis of field samples analyzed by the laboratory.

no action is necessary, unless 5 or more successive weakly discordant measurements are generated from a single laboratory. In this case, the QATS contractor will coordinate with the laboratory QAM to investigate potential reasons for discordance. If inter-laboratory results are ranked as poor, the QATS contractor shall investigate and may request corrective action, as necessary.

PE Standards – USGS has prepared site-specific reference materials of LA in soil for use during PLM-VE analyses (EPA 2008b). These reference materials were prepared by adding known aliquots of LA spiking material to uncontaminated soils to obtain several different nominal LA concentrations (based on mass percent). Aliquots of these reference materials (as well as other Libby-spiked soils) are utilized as PE standards to evaluate PLM laboratory accuracy and precision. PE standards of varying nominal levels are inserted into the PLM-VE sample train at the Troy SPF and provided to the laboratories blindly with the inter-laboratory samples.

Results for PE standards will be evaluated by the QATS contractor or their designate. PE standard results are ranked as acceptable if the correct semi-quantitative bin is reported, as determined by the nominal concentration of the PE standard. The LC should be notified if PE standard results do not meet acceptance criteria. Corrective action(s) will be taken if the PE standards demonstrate issues with accuracy and/or bias in PLM-VE results reporting. Examples of corrective actions that may be taken include reanalysis and/or re-preparation, collaboration between and among laboratories to address potential differences in analysis methods, and analyst retraining.

4.2 Laboratory QA Program

All samples collected at the Site will be analyzed in accordance with standard EPA and/or nationally recognized analytical procedures (i.e., Good Laboratory Practices). The purpose of using standard procedures is to provide analytical data of known quality and consistency.

Each analytical laboratory has developed a laboratory-specific QA management plan that provides a detailed description of the procedures and policies that are in place at their laboratory to ensure laboratory quality. This laboratory QA management plan will include information on standard laboratory methods and SOPs, instrument testing, inspection, maintenance, and calibration requirements, procedures for inspection of supplies and consumables, analyst training, facility contamination monitoring, and internal auditing. These laboratory QA management plans are reviewed and approved by the LC when the subcontracting agreement is established. Copies of all laboratory QA management plans for each project laboratory are maintained by the LC. The QATS contractor will also review the laboratory QA management plan during the annual project laboratory audit (see Section 4.2.4.1).

This section describes the laboratory certifications that are required of each laboratory that analyzes field samples from the Site. This section also describes the Libby laboratory team training/mentoring program, Site-specific analyst training requirements, and Site-specific audit procedures that ensure analytical results are of high quality.

In addition to the laboratory QA program requirements specified below, the analytical laboratories will be provided a copy of, and are expected to adhere to, any additional laboratory QA program requirements of the investigation-specific QAPPs.

4.2.1 Laboratory Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Each laboratory is accredited by the NIST/NVLAP for the analysis of airborne asbestos by TEM and/or analysis of bulk asbestos by PLM. This includes the analysis of NIST/NVLAP SRMs, or other verified quantitative standards, and successful participation in two proficiency rounds per year each of bulk asbestos by PLM and airborne asbestos by TEM supplied by NIST/NVLAP.

In addition, PCM laboratories are required to successfully participate in the PAT program of the AIHA. These are PCM proficiency testing samples submitted to the laboratories quarterly, directly from AIHA.

Copies of recent proficiency examinations from both NVLAP and the AIHA or an equivalent program are maintained by each participating analytical laboratory. Many of the laboratories also maintain certifications from other state and local agencies. Copies of all proficiency examinations and certifications are also maintained by the LC in the Libby project file.

Each laboratory working on the Libby project is also required to pass an on-site EPA laboratory audit. The details of this EPA audit are discussed in Section 4.2.4.1. The LC also reserves the right to conduct any additional investigations deemed necessary to determine the ability of each laboratory to perform the work. Each laboratory also maintains appropriate certifications from the state and possibly other certifying bodies (e.g., NYSDOH) for methods and parameters that may also be of interest to the Libby project. These certifications require that each laboratory has all applicable state licenses and employs only qualified personnel. Laboratory personnel working on the Libby project are reviewed for requisite experience and technical competence to perform asbestos PCM, PLM, and TEM analyses. Copies of personnel resumes are maintained for each participating laboratory by the LC in the Libby project file.

Each laboratory is required to abide by the Libby project Conflict of Interest disclosure policy stated below:

> *Conflict of Interest.* Laboratory cannot perform asbestos work for clients/consultants who (directly or indirectly) represent W.R. Grace and/or R.J. Lee. In addition, Libby and Libby Sister site samples collected by entities other than the EPA or EPA contractors cannot be analyzed by the laboratory without explicit consent from the EPA.
>
> *Capacity.* Laboratory cannot perform asbestos work for other sites or clients if it will impact the capacity to perform quality and timely analytical work for the Libby site.

As part of the laboratory contract award, each laboratory has provided a signed acknowledgement statement of this policy on company letterhead. Copies of the signed statements of acknowledgement for each participating laboratory are maintained by the LC in the Libby project file.

4.2.2 Laboratory Team Training/Mentoring Program

4.2.2.1 Initial Mentoring

The orientation program to help new laboratories gain the skills needed to perform reliable analyses at the Site involves successful completion of a training/mentoring program that was developed for new laboratories prior to their analysis of Libby field samples. All new laboratories are required to participate in this program. The training program includes a rigorous 2-3 day period of on-site training provided by senior personnel from those laboratories already under contract on the Libby project, with oversight by the QATS contractor. The tutorial process includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on project-specific analytical methodology, documentation, and administrative procedures used on the Libby site. The mentor will also review the analysis of at least one sample by each type of analytical method with the trainee laboratory.

4.2.2.2 Site-Specific Reference Materials

TEM

Because LA is not a common form of asbestos, USGS prepared site-specific reference materials using LA collected at the Libby mine site (EPA 2008b). Upon entry into the Libby program, each laboratory is provided samples of these LA reference materials. Each laboratory is required to analyze multiple LA structures present in these samples by TEM in order to become familiar with the physical and chemical appearance of LA and to establish a reference library of LA EDS spectra. These laboratory-specific and instrument-specific LA reference spectra (EPA 2008c) serve to guide the classification of asbestos structures observed in Libby field samples during TEM analysis.

PLM

USGS has also prepared site-specific reference materials of LA in soil for use during PLM-VE analysis (EPA 2008b). These reference materials were prepared by adding aliquots of LA spiking material to uncontaminated Libby soils to obtain nominal LA concentrations of 0.2% and 1.0% (by weight). Each laboratory was provided with samples of these reference materials for use in training PLM-VE analysts in the visual area estimation of LA levels in soil. In addition, aliquots of these reference materials (as well as other spiked soils) are also utilized as PE standards to evaluate PLM-VE laboratory accuracy.

4.2.2.3 Regular Technical Discussions

On-going training and communication is an essential component of QA for the Libby project. To ensure that all laboratories are aware of any technical or procedural issues that may arise, a regular teleconference is held between the EPA, their contractors, and each of the participating laboratories. Other experts (e.g., USGS) are invited to participate when needed. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications. It is the responsibility of the ESAT LC to schedule and organize these technical discussions.

4.2.2.4 Professional/Technical Meetings

Another important aspect of laboratory team training has been the participation in technical conferences. The first of these technical conferences was hosted by USGS in Denver, Colorado, in February 2001, and was followed by another conference held in December 2002. The Libby laboratory team has also convened on multiple occasions at the ASTM Johnston Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conference in January 2010 and January 2013. In addition, members of the Libby laboratory team attended an EPA workshop to develop a method to determine whether LA is present in a sample of vermiculite attic insulation held in February 2004 in Alexandria, Virginia. These conferences enable the Libby laboratory and technical team members to have an on-going exchange of information regarding all analytical and technical aspects of the project, including the benefits of learning about developments by others.

4.2.3 Analyst Training

4.2.3.1 PCM

There are no project-specific training requirements for PCM analysts.

4.2.3.2 PLM

All PLM analysts for the Libby project are expected to be familiar with routine chemical laboratory procedures, principles of optical mineralogy, and proficient in EPA Method 600/R-93/116, NIOSH Method 9002, CARB Method 435, and Site-specific SOPs SRC-LIBBY-01 and SRC-LIBBY-03. Analysts with less than one year of experience specific to the Libby project are required to participate in the laboratory mentoring program to obtain additional guidance and instruction. This training is provided by the laboratory managers and/or senior PLM analysts that are familiar with the types of asbestos and analytical challenges encountered at the Site. Before performing any Site analyses, the analyst must demonstrate the ability to generate acceptable accuracy and precision for the LA-specific reference materials.

Satisfactory completion of each of these training tasks must be approved by a senior PLM analyst. A training checklist or logbook is used to ensure that the analyst has satisfactorily completed each specific training requirement. It is the responsibility of the laboratory QAM to ensure that all analysts have completed the required training requirements.

4.2.3.3 TEM

All TEM analysts for the Libby project undergo extensive training to understand TEM theory and the application of standard laboratory procedures and methodologies. The training is typically performed by a combination of personnel, including the laboratory manager, the laboratory QAM, and senior TEM analysts.

In addition to the standard TEM training requirements, trainees involved with the Libby project must familiarize themselves with Site-specific method deviations, project-specific documents, and visual references. Standard samples that are often used during TEM training include known pure (traceable) samples of chrysotile, amosite, crocidolite, tremolite, actinolite and anthophyllite, as well as fibrous non-asbestos minerals such as vermiculite, gypsum, antigorite,

kaolinite, and sepiolite. New TEM analysts on the Libby project are also required to perform an *EDS Spectra Characterization Study* (EPA 2008c) on the LA-specific reference materials provided during the initial training program to aide in LA mineralogy recognition and definition. Satisfactory completion of each of these tasks must be approved by a senior TEM analyst.

All TEM analysts are also trained in the Site-specific laboratory QA/QC program requirements for TEM (see Section 4.1.2.2). The entire program is discussed to ensure understanding of requirements and responsibilities. In addition, analysts are trained in the project-specific reporting requirements and data reporting tools utilized in transmitting results. Upon completion of training, the TEM analyst is enrolled as an active participant in the Libby laboratory program.

A training checklist or logbook is used to assure that the analyst has satisfactorily completed each specific training requirement. It is the responsibility of the laboratory QAM to ensure that all TEM analysts have completed the required training requirements.

4.2.4 Laboratory Audits

Each laboratory working on the Libby project is required to participate in an annual on-site laboratory audit carried out by the EPA through the QATS contract. These audits are performed by EPA personnel (and their contractors) that are external to and independent of the Libby laboratory team members. These audits ensure that each analytical laboratory meets the basic capability and quality standards associated with analytical methods for asbestos used at the Libby site. They also provide information on the availability of sufficient laboratory capacity to meet potential testing needs associated with the Site.

4.2.4.1 External Audits

Audits consist of several days of technical and evidentiary review of each laboratory. The technical portion of the audit involves an evaluation of laboratory practices and procedures associated with the preparation and analysis of samples for the identification of asbestos. The evidentiary portion of the audit involves an evaluation of data packages, record keeping, SOPs, and the laboratory QA manual. A checklist of method-specific and project-specific requirements for the commonly used methods for asbestos analysis, including PLM, TEM, and PCM, is prepared by the auditor prior to the audit, and used during the on-site laboratory evaluation.

Evaluation of the capability for a laboratory to analyze a sample by a specific method involves observing analysts performing actual sample analyses and interviewing each analyst responsible for the analyses. Observations and responses to questions concerning items on each method-specific checklist are noted. The determination as to whether the laboratory has the capability to analyze a sample by a specific method depends on how well the analysts follow the protocols detailed in the formal method, how well the analysts follow the laboratory-specific method SOPs, and how the analysts respond to method-specific questions.

Evaluation of the evidentiary capabilities of the laboratory involves reviewing laboratory documentation and interviewing laboratory personnel responsible for maintaining laboratory documentation. This includes personnel responsible for sample check-in, data review, QA procedures, document control, and record archiving. Certain analysts responsible for method

quality control, instrument calibration, and document control are also interviewed in this aspect of the audit. Determination as to the capability to be sufficient in this aspect is made based on staff responses to questions and a review of archived data packages and QC documents.

It is the responsibility of the QATS contractor to prepare an On-site Audit Report for each analytical laboratory participating in the Libby program. These reports are handled as business confidential items. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each laboratory to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

As part of the annual QC report, the QATS contractor prepares an On-Site Audit Trend Analysis Report. This report will include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this reported is to identify common asbestos laboratory performance problems and isolate the potential causes.

4.2.4.2 Internal Audits

Each laboratory will also conduct periodic internal audits of their specific operations. Details on these internal audits are provided in the laboratory QA management plan. The laboratory QAM should immediately contact the LC and the QATS contractor if any issues are identified during internal audits that may impact data quality for Site samples.

4.2.5 Laboratory Contamination Monitoring

An environmental contamination monitoring program is required at each laboratory that analyzes samples from Libby. Specifics regarding the requirements of the laboratory monitoring program for each laboratory are described in the laboratory QA management plan. The laboratory QAM should immediately contact the LC and the QATS contractor of any laboratory contamination monitoring results that are outside of the appropriate acceptance criteria.

4.3 Holding Times

Holding times are storage times allowed between sample collection and sample analysis when the designated preservation and storage techniques are employed. No preservation requirements or holding times are established for air, dust, soil, insulation, duff, or tree bark samples collected for asbestos analysis. The only exception to these holding times is related to filters and soil samples that are wet and water samples. Because moisture can promote the growth of mold, wet filters and soil samples must be refrigerated if delivery to a laboratory for drying cannot be completed within 24 hours.

For water samples, if water samples will be prepared using ozonation/UV light treatment prior to filtration, there are no holding time requirements. If ozonation/ultraviolet light treatment will not be performed, collected water should be filtered as soon as possible from the time of collection (maximum holding time of 48 hours). If water samples are not filtered within 48 hours, bacterial and algal growth has the potential to influence the reporting of structures in the TEM analysis. *The investigation-specific QAPP will specify the required preparation methods and holding times for water.*

4.4 Analytical Results Turn-around Times

The analytical results turn-around times required for each investigation will vary. *The investigation-specific QAPPs will include information regarding the expected turn-around time for results related to each investigation.* When expedited turn-around times are required (less than 2 weeks) for any investigation sample, the LC will be informed as soon as possible during the investigation planning phase. The LC will be responsible for determining which analytical laboratories will be utilized to meet required turn-around times for each investigation.

4.5 Laboratory Custody Procedures and Documentation

Specific laboratory custody procedures are provided in the laboratory QA management plan. While specific laboratory sample custody procedures may differ between laboratories, the basic laboratory sample custody process is described below.

Upon receipt at the analytical laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples, as well as verifying sample integrity. The accompanying COC records will be cross-referenced with all of the samples in the shipment. The laboratory sample coordinator will sign the COC records and maintain a copy for the laboratory project files. A copy of the final, signed COC will be scanned and emailed to the SPF sample coordinator and the appropriate project data manager. A copy of the final, signed COC will be appended to the hardcopy data report that is sent to the LC.

Depending upon the laboratory-specific tracking procedures, the laboratory sample coordinator may assign a unique laboratory identification number to each sample on the COC. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the responsibility of the laboratory manager to ensure that internal logbooks and records are maintained throughout sample preparation, analysis, and data reporting.

4.6 Documentation and Records

4.6.1 Analytical Data Reports

An analytical data report will be prepared by the laboratory and submitted to the LC after the completion of all required analyses within a specific laboratory job (or sample delivery group). This analytical data report includes a case narrative that briefly describes the analytical methods, deviations from the methods, revisions to data reports, COC discrepancies, etc. The data report will also include copies of the signed COC forms, sample preparation logs, and analytical bench sheets. The data report may also include spectra print outs, grid sketches, instrument preparation logs, instrument print outs, instrument maintenance records, analysis run logs, etc. All scanned copies of analytical data reports will be uploaded to the FTP site (ftp://regionalftp.ert.org). For OU3, scanned copies of all analytical data reports are also posted on the Libby OU3 eRoom (see **Appendix B**).

4.6.2 Laboratory Data Reporting Tools

Standardized data reporting tools (i.e., EDDs) have been developed specifically for the Libby project to ensure consistency between different laboratories in the presentation and submittal of

analytical data. In general, unique Libby-specific EDDs have been developed for each analytical method. Since the beginning of the Libby project, each EDD has undergone continued development and refinement to better accommodate current and anticipated future data needs and requirements. EDD refinement continues based on laboratory and data user input. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom (see **Appendix B**).

The EDDs for TEM and the Site-specific PLM methods (PLM-VE and PLM-GRAV) are Microsoft® Excel spreadsheets developed specifically for use at Libby. In general, there is one TEM EDD for each type of media (i.e., air, water, tree bark, soil, duff, and tissue). Each EDD contains a variety of built-in QC functions that improve the accuracy of data entry and help maintain data integrity. For example, data entry forms utilize drop-down menus whenever possible to standardize data inputs and prevent transcription errors. In addition, many data input cells are coded to highlight omissions, apparent inconsistencies, or unexpected values so that data entry personnel can check and correct any errors before submittal of the EDD. For TEM, these spreadsheets also perform automatic computations of analytical sensitivity, dilution factors, loading, and concentration, thus reducing the likelihood of analyst calculation errors.

For non-OU3 investigations, EDDs are both transmitted electronically via email to the ESAT LC and also uploaded to the same FTP site as the scanned deliverable.

For OU3 investigations, EDDs are posted to the Libby OU3 eRoom. The project database manager (CDM Smith) then uploads these EDDs directly to the OU3 master project database (see Section 6.2.4).

ESAT has developed a new Site-specific analytical results reporting tool, referred to as the Libby Asbestos Data Tool (LADT). This tool is a relational Microsoft® Access database with a series of standard data entry forms specific to the PLM-VE and PLM-GRAV methods. The LADT creates a Microsoft® Excel export file that can be directly uploaded into an analytical Scribe project database (see Section 6.1.3).

4.6.3 Documentation Corrections and Modifications

A single strikeout, initial, and date is required for documentation of any corrections in the analytical bench sheets and logbooks. The correct information will be entered in close proximity to the erroneous entry. As needed, corrected EDDs will be re-sent, with the designation that the EDD is a correction (to alert data managers to the fact that the erroneous EDD should be replaced

All deviations from project-specific and method guidance documents will be recorded on the appropriate Libby ROM Form (see **Appendix D**). The ROM will be used to document all permanent and temporary changes to analytical procedures. ROMs are completed by the appropriate laboratory or technical staff. As ROMs are completed, it is the responsibility of the LC to communicate any changes to the project laboratories. When the project management team determines the need, revised governing documents may be issued to incorporate modifications.

For OU3, each completed ROM is assigned a unique number that is specific to each investigation-specific QAPP (e.g., Phase I LFM-OU3-02) by the OU3 CDM Smith PM or their

delegate. Once a form is prepared, it is submitted to the OU3 EPA RPM for review and approval. Copies of all approved ROMs are available on the Libby OU3 website (see **Appendix B**).

For all other OUs, each laboratory ROM is assigned a unique sequential number (e.g., LB-000088) by the QATS contractor. A ROM tracking log for all laboratory modifications is maintained by the QATS contractor. This tracking log briefly describes the ROM being documented, the type of ROM (temporary or permanent), the effective date, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the ESAT QAM (or their designate) for review. Final review and approval is provided by the appropriate EPA RPM or MDEQ project manager with input from the EPA TAU chief. Copies of approved ROMs are available in the Libby Lab eRoom (see **Appendix B**).

4.7 Final Sample Storage and Archive

For non-OU3 samples, after six months from submittal of complete deliverables (EDD and scanned hardcopy) all soil samples will be packaged for shipment to an ESAT archive facility. All samples received for TEM analyses (i.e. filter cassettes, soil samples and/or indirect prepare filters) must remain at the laboratory until after selection of samples for the annual TEM inter-laboratory study. All sample shipments must include a copy of the original COC in the sample shipment. Copies of this relinquished COC form should be kept by the analytical laboratory to document this transfer of sample custody. Prepared TEM grids should also remain in archive at the analytical laboratory.

For OU3 samples, all samples sent for analysis are to be archived in a secure area and under proper COC at the analytical laboratory. Samples will be shipped as directed by the client. All sample shipment must include a copy of the original COC in the sample shipment. Copies of this relinquished COC form should be kept by the analytical laboratory to document this transfer of sample custody.

Section 5 Troy Sample Preparation Facility Methods and Requirements

Soil samples delivered to the Troy Sample Preparation Facility (Troy SPF), for analysis by PLM or the Fluidized Based Asbestos Segregator (FBAS), are processed in accordance with the following SOPs:

- ISSI-LIBBY-01 - This SOP describes the processes for drying, splitting, sieving, grinding, and archiving of soil samples, which are shipped to an approved laboratory for analysis by PLM.

- SOP ESAT-LIBBY-01 – This SOP describes the processes for generating air filter samples using the by the Fluidized Bed Asbestos Segregator (FBAS) , which are shipped to an approved laboratory for analysis by TEM.

Both of the above processes are performed at the preparation facility located in Troy, Montana.

The QA/QC applied to these soil preparation processes includes adherence to standard preparation procedures, submission of preparation QC samples, facilities monitoring, and internal audits, which are described in the SOPs ISSI-LIBBY-01 and ESAT-LIBBY-01; the troy SPF *Quality Assurance Manual,* and the *Troy SPF's Site Health and Safety Plan*. The most recent versions of these documents are available the Libby Lab eRoom (see **Appendix B**).

In addition to processing soil samples, the Troy SPF also acts as a transit facility for non-OU3 samples for other (non-soil) media. The Troy SPF accepts samples from the field and ships them to the appropriate analytical laboratory for analysis.

5.1 Facility Procedures

QA/QC procedures at the Troy SPF are included in all phases of soil processing. Specific checks for each phase of soil processing are discussed in the following sections.

5.1.1 Sample Receipt and Check-In

Upon arrival at the Troy SPF, samples are checked-in by the SPF sample coordinator to verify that sample number labels match the COCs contained in the shipping containers. If any discrepancies are found, they must be documented and communicated as described in the latest revision of the Libby Chain-of-Custody Documentation SOP (ER8-Libby-01). If no discrepancies are found, the SPF sample coordinator will indicate on the COC that the shipment was complete and will sign and date the COC form.

To ensure sample check-in procedures are being completed correctly, each day when samples are received, the associated COCs will be reviewed and verified against the shipment contents by a second SPF staff member to ensure that the information on the COC matches the information on the sample labels. The reviewer will initial and date the COC forms after this review. If any discrepancies are found, they must be documented and communicated as

described in the latest revision of the Libby Chain-of-Custody Documentation SOP (ER8-Libby-01).

5.1.2 Equipment Calibration

Soil processing instrumentation requiring calibration or routine function checks include the FBAS, sample grinders, drying ovens, ventilation hood, high-efficiency particulate air (HEPA) vacuum, hood anemometer, and the analytical balance. A detailed description of the calibration and maintenance procedures for each type of equipment is provided in the applicable SOPs and/or the *Soil Sample Preparation Work Plan.*

All calibration and maintenance checks are documented on equipment-specific calibration and maintenance log sheets, as provided in SOPs ISSI-LIBBY-01 and ESAT-LIBBY-01. These calibration and maintenance log sheets are kept in ringed binders, which are pre-numbered with the equipment number and arranged according to equipment type. It is the responsibility of the SPF QAM (or their designate) to verify that the calibration of each piece of equipment is checked daily and is operating within normal parameters.

5.1.3 Soil Sample Preparation for Analysis by PLM

All soil samples received for PLM analyses are processed in accordance with SOP ISSI-LIBBY-01. In brief, each soil sample is dried and split into two equal portions. One portion is archived and the other is sieved through a ¼-inch screen. Particles retained on the screen (if any) are referred to as the "coarse" (C) fraction. Particles passing through the screen are referred to as the fine ground (FG) fraction, which is ground by passing it through a plate grinder. The fine ground fraction is split into four equal aliquots; with one of the aliquots submitted for PLM analysis, and the remaining three aliquots archived for the possible future analyses.

For each soil sample, the resulting fractions are each placed into individual zip-top bags that are then labeled using a permanent marker with the sample number and a fraction-specific suffix as follows:

- A – archive fraction
- C – coarse fraction
- FGx – fine ground fraction, where 'x' is the aliquot number (e.g., FG1)

5.1.4 Soil Sample Preparation by FBAS

Soil samples are delivered to the Troy SPF where the sample is dried, homogenized, split, sieved, mixed with clean quartz sand, and placed in the glass vessel of the FBAS. Once in the FBAS, small (nominally < 10 microns) airborne particles are collected onto standard methyl cellulose ester (MCE) air filters, which are shipped to an approved laboratory where it is analyzed for asbestos by TEM.

5.1.5 Sample Storage

Whenever soil samples are not being processed, they will be stored in plastic bins or shipping boxes/coolers. The samples do not require refrigeration but must be kept in an orderly, clean fashion. All bins will be assigned a Bin ID, which is a four digit consecutive number starting with 0001. This Bin ID will reside on a prominent hanging tag. Bins will be arranged on labeled shelves by the Bin ID for easy retrieval. All bins will also be labeled with one or more inventory batch numbers. The inventory batch number is an assigned identifier in the following format: 12-1014, where 12 = two digit calendar year (as in 2012) and 1014 = four digit consecutive number, starting with 0001. Bin information is tracked by the SPF sample coordinator in an Excel file, which indicates the Bin ID, inventory batch number, bin contents, and its physical location within the SPF.

5.1.6 Sample Packaging and Shipping

During soil sample and FBAS air filter packaging, the SPF sample coordinator will check the visual appearance of each sample against the COC to ensure that each sample is labeled correctly. Prior to shipment, a second SPF staff member will check the container contents to ensure sample labels are correct and that no samples with duplicate or missing labels are present. The COC will also be checked to ensure that the correct analysis was requested, the correct shipping date and air bill number is recorded, and that all samples listed on the COC are included in the shipment. The reviewer will initial and date the COC forms after review. If any discrepancies are found, they must be documented and communicated as described in the latest revision of the Libby Chain-of-Custody Documentation SOP (ER8-Libby-01).

5.1.7 Documentation

5.1.7.1 Sample Drying and Preparation Log Sheets

During sample drying and preparation, detailed information on sample mass during each step of the process is recorded on Site-specific sample drying and preparation log sheets, as provided in SOPs ISSI-LIBBY-01 and ESAT-LIBBY-01. As these log sheets are completed, one of the SPF personnel (other than the individual who completed the original log sheet) will check to ensure the data are accurate and complete. If errors are observed during the check, corrections will be made by the person that originally completed the log sheets. All log sheets are maintained and archived at the Troy SPF. Scanned copies of log sheets are maintained on the ESAT network drive. These scanned copies are also emailed to the appropriate project data manager.

5.1.7.2 Soil Preparation Logbooks

Details regarding each sample preparation step will be recorded in the soil preparation logbook. The log is an accounting of activities and will duly note problems or deviations from the governing plans and observations relating to the soil preparation activities that are not already captured on the log sheets. A person other than the individual who completed the original soil preparation logbook entries will check logbook entries each day. This is done to ensure that all relevant information has been recorded. If any logbook entries are incorrect or incomplete, the reviewer will notify the original author to make the appropriate corrections. If necessary, the original author will be retrained on soil preparation logbook documentation procedures.

5.1.7.3 SPF Scribe Database

Two separate local SPF Scribe databases, one each for PLM and FBAS, are used to track specific information associated with the soil sample preparation process (see Section 6.1.2 for detailed information on the local SPF Scribe database). SPF personnel perform data entry of preparation information from the sample drying and preparation log sheets into an Excel spreadsheet. Preparation data are then uploaded from this spreadsheet into the local SPF Scribe database.

A person other than the individual who completed the original data entry will check 100% of the data entered into the database on a weekly basis. The data entry check will be documented in the preparation logbook. If data entry discrepancies are discovered during the QC check, a correction will be made to the entered data, and the SPF personnel will be retrained on data entry procedures, as appropriate.

Soil sample preparation information will be published to Scribe.NET regularly from the local SPF Scribe project database by the SPF sample coordinator (see Section 6.1.2 for additional details).

5.1.7.4 COCs

The local SPF Scribe project database is used by the SPF sample coordinator or the ESAT project data manager[j] to prepare an electronic COC. One hardcopy of the COC will be generated from the electronic COC and will accompany the sample shipment. The SPF will sign and date the COC and make a copy for the SPF project file. Information on the COC number and analytical laboratory to which the soil samples were shipped is managed in Google Docs by the SPF sample coordinator (or their designate

Upon receipt at the analytical laboratory, the analytical laboratory sample coordinator will scan and email a copy of the final signed COC to the SPF sample coordinator and the appropriate project data manager.

If any discrepancies are found on the COC after shipment, they must be documented and communicated as described in the latest revision of the Libby Chain-of-Custody Documentation SOP (ER8-Libby-01).

5.1.7.5 Documentation Corrections and Modifications

A single strikeout, initial, and date is required for documentation of any corrections in the log sheets and logbooks. The correct information will be entered in close proximity to the erroneous entry. Information inserted into laboratory documents with adhesive labels shall be affixed permanently in place. The individual responsible for inserting information shall sign and date across the insert and logbook page at the time information is added.

All deviations from soil preparation guidance documents will be recorded on the appropriate Libby ROM Form (see **Appendix D**). ROMs are completed by the appropriate SPF or technical staff. Upon completion, each SPF ROM is assigned a unique sequential number (e.g., SPF-

[j] The ESAT project data manager is responsible for creating the COCs for soil samples prepared using the FBAS and for all samples from OU7.

00002) by the QATS contractor. A ROM tracking log for all SPF modifications is maintained by the QATS contractor. This tracking log briefly describes the ROM being documented, the type of ROM (temporary or permanent), the effective date, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the ESAT QAM (or their designate) for review. Final review and approval is provided by the appropriate EPA RPM or MDEQ project manager with input from the EPA TAU chief. Copies of approved ROMs are available in the Libby Lab eRoom (see **Appendix B**). When the project management team determines the need, revised governing documents may be issued to incorporate modifications.

5.2 Preparation QC Samples

Nine types of preparation QC samples are collected during the soil preparation and FBAS processes: sand blanks, drying blanks, grinding blanks, and preparation duplicates, and sieve blanks. Each type of preparation QC sample is described in more detail below. **Table 5-1** summarizes the collection frequency and acceptance criteria for each type of preparation QC sample. *Unless specified otherwise in the investigation-specific QAPPs,* the following collection frequencies and acceptance criteria apply.

5.2.1 PLM QC Samples

5.2.1.1 Sand Blanks

A sand blank is a sample of store-bought quartz sand that is analyzed to ensure that the quartz sand matrix used for drying and grinding blanks is asbestos-free. Detailed procedures for this certification process are provided in ESAT SOP PLM-02.00, *Blank Sand Certification by Polarized Light Microscopy*. In brief, about 800 grams of sand is split into 40 sand blank aliquots of roughly equal size. Each sand blank is evaluated using stereomicroscopic examination and analyzed by PLM-VE. If a sand blank has detected asbestos, it is re-analyzed by a second PLM analyst to verify the presence of asbestos. The sand is certified as asbestos-free if all 40 sand blanks are non-detect for asbestos. The sand is rejected for use if any asbestos is detected in the sand blanks. Only sand that is certified as asbestos-free will be utilized in the SPF.

5.2.1.2 Preparation Blank (Drying Blank)

A drying blank consists of approximately 100 to 200 grams of asbestos-free quartz sand that is processed with each batch of field samples that are dried together (usually this is approximately 125 samples per batch). The drying blank is then processed identically to field samples. Drying blanks determine if cross-contamination between samples is occurring during sample drying. One drying blank will be processed with each drying batch per oven. It is the responsibility of the SPF QAM to ensure that the appropriate number of drying blanks is collected. Each drying blank is given unique sample number that is investigation-specific, as provided by the field sample coordinator (i.e., a subset of sample numbers for each investigation will be provided for use by the SPF). SPF personnel will record the sample number of the drying blank on the sample drying log sheet.

It is the responsibility of the QATS contractor (or their designate) to review the drying blank results and notify the SPF QAM immediately if drying blank results do not meet acceptance criteria and if corrective actions are necessary. If asbestos is detected by PLM-VE in the drying blank (i.e., result is not Bin A), a qualifier of "DB" will be added to the related field sample

results in the project database that were dried at the same time as the detected drying blank to denote that the associated drying blank had detected asbestos. In addition, the drying oven will be thoroughly cleaned. If asbestos continues to be detected in drying blanks after cleaning occurs, sample processing must stop and the drying method and decontamination procedures will be evaluated to rectify any cross-contamination issues. (See Section 6.4 for additional information on data qualifiers.)

5.2.1.3 Grinding Blanks

A grinding blank consists of asbestos-free quartz sand and is processed along with the field samples on days that field samples are ground. Grinding blanks determine if decontamination procedures of laboratory soil processing equipment used for sample grinding and splitting are adequate to prevent cross-contamination. Grinding blanks are prepared at a frequency of one per grinding batch per grinder per day. It is the responsibility of the SPF QAM to ensure that the appropriate number of grinding blanks are collected. Each grinding blank is given unique sample number that is investigation-specific, as provided by the field sample coordinator. SPF personnel will record the sample number of the grinding blank on the sample preparation log sheet.

It is the responsibility of the QATS contractor (or their designate) to review the grinding blank results and notify the SPF QAM immediately if grinding blank results do not meet acceptance criteria and if corrective actions are necessary. If any asbestos is detected by PLM-VE in the grinding blank (i.e., result is not Bin A), a qualifier of "GB" will be added to the related field sample results in the project database that were ground at the same time as the detected grinding blank to denote that the associated grinding blank had detected asbestos. In addition, the grinder will be thoroughly cleaned. If asbestos continues to be detected in grinding blanks after cleaning occurs, sample processing must stop and the grinding method and decontamination procedures will be evaluated to rectify any cross-contamination issues. (See Section 6.4 for additional information on data qualifiers.)

5.2.1.4 Preparation Duplicates

Preparation duplicates are splits of field samples submitted for sample preparation. The preparation duplicates are used to evaluate the variability that arises during the soil preparation and analysis steps. After drying, but prior to sieving, a preparation duplicate is prepared by using a riffle splitter to divide the field sample (after an archive split has been created) into two approximately equal portions, creating a parent and duplicate sample.

Preparation duplicate samples are prepared at a rate of 1 per 20 samples (5%) of samples prepared. It is the responsibility of the SPF QAM to ensure that the appropriate number of preparation duplicates is prepared. Each preparation duplicate is given unique sample number that is investigation-specific, as provided by the field sample coordinator. SPF personnel will record the sample number of the preparation duplicate and its associated parent field sample on the sample preparation log sheet. Preparation duplicates are submitted blind to the laboratory for analysis by the same analytical method as the parent sample.

Preparation duplicate results will be considered concordant if the reported PLM bin for the preparation duplicate is within one bin of the original parent field sample. The variability between the preparation duplicate and the associated field sample reflects the combined

variation due to sample preparation and due to measurement error. Results for preparation duplicate samples are evaluated by the QATS contractor or their designate. If the concordance rate for preparation duplicate samples is less than 10%, the QATS contractor will notify the SPF QAM to determine if corrective action is needed.

5.2.2 FBAS QC Samples

5.2.2.1 Sieve Blanks

A sieve blank consists of approximately 50 grams of clean asbestos-free quartz sand, which is run through the entire FBAS sample preparation process. Sieve blanks are used to evaluate the cleanliness of the Troy SPF and process and to determine if decontamination procedures are adequate. Sieve blanks shall be run at a frequency of one per every 20 field samples or each batch processed, whichever is more frequent. Sieve blanks should be run around the middle or end of an analytical batch, but never at the beginning. The laboratory that performs the analysis should record all asbestos fibers with a length > 0.5 µm and an aspect ratio > 3:1. Since sieve blanks have a sample weight of zero (they contain 50 grams of sand but no field soil), it is not possible to apply a target analytical sensitivity (expressed as fibers per gram) to them. For this reason, the stopping rule for the TEM analysis will be to analyze an area of 0.25 mm^2, unless specified otherwise in project planning documents. All sieve blanks will be analyzed unless otherwise specified in project planning documents. A sieve blank is assigned to the same chain of custody as the field samples it is associated with and is shipped with the other cassettes to the analytical lab. Results of sieve blanks will be tracked to monitor contamination as it relates to the entire process.

5.2.2.2 Filter Lot Blanks

One filter lot blank should be submitted for TEM analysis for each lot of 500 filter cassettes used for the FBAS project. A filter lot blank will be analyzed before a new lot of cassettes are used for field samples. Filter lot blanks are analyzed by the ISO 10312 TEM method and all applicable current Libby Lab ROMs (see Section 4.1.2.1). The TEM laboratory that performs the analysis should record all asbestos fibers with a length ≥ 0.5 µm and an aspect ratio ≥ 3:1, and employ a stopping rule of 0.1 mm^2 analyzed, *unless specified otherwise in the investigation-specific QAPPs*. The filter lot must be rejected if any asbestos fibers (LA, other amphibole, or chrysotile) are observed during the analysis. If a filter lot blank passes, indication on the boxes of cassettes associated with that blank of their passing status will be recorded, along with initials and date.

5.2.2.3 Sieve Duplicate

After the fluidized bed fraction of a field soil sample has been split to produce parent and duplicate fractions, they are sent through the remainder of the preparation and analytical process as separate samples. Each fraction is independently sieved and processed by the FBAS onto its own MCE filter. Results of analyses on sieve duplicates will be tracked to monitor precision of the entire process, with inconsistent results taken as an indication of variability in sample preparation. Sieve duplicates will be performed at a rate of one per 20 field samples (or each batch processed together, whichever rate is higher) unless specified otherwise in relevant project planning documents such as a SAP or QAPP.

5.2.2.4 Preparation Blanks

A preparation blank is a filter that is left uncovered on the bench top inside the FBAS hood during processing of soil samples with the FBAS, and used as a measure of general laboratory cleanliness. Preparation blanks will be produced at a rate of one per day for each day the FBAS is operated. If more than one analytical batch (i.e., samples for more than one chain of custody) is processed in a given day, a separate preparation blank will be produced for each batch. All preparation blanks will be analyzed unless otherwise specified in project planning documents. A preparation blank is assigned to the same COC as the field samples it is associated with and is shipped with the other cassettes to the analytical laboratory. Preparation blanks are analyzed by the ISO 10312 TEM method and all applicable current Libby Lab ROMs (see Section 4.1.2.1). The TEM laboratory that performs the analysis should record all asbestos fibers with a length ≥ 0.5 µm and an aspect ratio ≥ 3:1. The stopping rule in effect for preparation blanks will be for the lab to analyze an area of 0.1 mm^2, *unless specified otherwise in the investigation-specific QAPPs*. If any analyzed preparation blank is found to contain any level of LA asbestos, the SPF shall immediately investigate the source of the contamination and take steps to eliminate the source of contamination before preparation of any samples may continue.

5.2.2.5 FBAS Replicate

The Troy SPF will not collect any FBAS replicates unless specifically directed to do so in project planning documents. FBAS replicates are multiple FBAS runs from the same bag of sieved soil. Approximately 1-gram aliquots (5 grams for those prepared by the Rock Flour Prep technique) of soil are collected from the same bag of sieved soil for the first run and any FBAS replicate runs. Each soil/sand mixture is processed through the FBAS onto its own MCE filter. Results of FBAS replicates will be tracked to monitor precision of the FBAS method.

5.3 Performance Evaluation Standards

As noted previously, the USGS prepared several Site-specific reference materials of LA in soil that are utilized as PE standards to evaluate laboratory accuracy and precision of soils samples prepared for analysis by PLM and TEM. These PE standards are kept in storage at the Troy SPF and are inserted into the sample train during soil sample processing. PE standards of varying nominal levels will are inserted at a rate to be determined by the client. Each PE standard is given unique sample number provided by the field sample coordinator. SPF personnel will record the sample number of the PE standard, the nominal level of the PE standard, and whether it was inserted pre- or post-processing on the sample preparation log sheet. PE standards are submitted blind to the laboratory for analysis using the same analytical method as the associated field samples.

Results for PE standards will be evaluated by the QATS contractor or their designate. See Section 4.1.3.2 for details on how PE standard results will be evaluated.

5.4 Housekeeping

The Troy SPF follows standard laboratory housekeeping practices to ensure the cleanliness of the facility. General housekeeping activities that are to be completed by the SPF are specified in the *Soil Sample Preparation Work Plan* and the SPF *HASP*. In brief, these housekeeping activities include, but are not limited to:

- Wet-wiping and HEPA vacuuming the walls and counter top of the negative flow HEPA hood and areas of sample handling and preparation at the end of each day.
- Wet-wiping and HEPA vacuuming the sample drying oven after each batch of samples.
- Utilizing dedicated shoes and booties that remain in the containment area of the laboratory to reduce the volume of material brought into the laboratory from the outside and the potential for tracking of materials throughout the laboratory

5.5 Equipment Decontamination

All soil processing equipment will be decontaminated prior to use in accordance with procedures in SOPs ISSI-LIBBY-01 and ESAT-LIBBY-01. In brief, all scoops, spoons, splitters, sieves, drying pans, grinders and FBAS equipment that are re-used must be decontaminated with a HEPA vacuum, compressed air, wet-wiping and/or by brushing off any residual material. If soil particles are visible on any of the equipment, the decontamination procedure must be repeated until the equipment is clean. This decontamination will be conducted after and/or before each sample is in direct contact with any piece of equipment.

5.6 Facility Contamination Monitoring

A facility contamination monitoring program at the Troy SPF evaluates potential staff exposures and documents facility cleanliness. Specifics regarding the requirements of this monitoring program are described in the SPF *HASP*. It is the responsibility of the SPF QAM to evaluate the results of the facility contamination monitoring to determine if they meet the acceptance criteria. The SPF QAM should immediately contact the LC and the QATS contractor any monitoring results that are outside of the appropriate acceptance criteria.

5.7 Training and Personnel Requirements

Personnel performing sample preparation activities must have read and understood this QARD, the *Soil Sample Preparation Work Plan*, the SPF *HASP*, and all associated SOPs and governing documents for soil preparation (e.g., SOP ISSI-LIBBY-01). In addition, all personnel must have completed 40-hour OSHA HAZWOPER training, annual updates, annual respirator fit tests, and annual or semi-annual physicals, as required.

Prior to performing activities at the Troy SPF, new personnel will be instructed by an experienced member of the SPF staff and training sessions will be documented in the SPF project files. It is the responsibility of the SPF QAM to ensure that all personnel have completed the required training requirements.

5.8 Audits

Internal audits of the SPF are conducted by the SPF QAM periodically to evaluate personnel in their day-to-day activities and to ensure that all processes and procedures are performed in accordance with governing documents and SOPs. All aspects of sample preparation, as well as sample handling, custody, and shipping are evaluated. If any issues are identified, SPF personnel are notified and retrained as appropriate. Audit reports will be completed following

each laboratory audit. A copy of the internal audit report, as well as any corrective action reports, will be provided to the LC and the QATS contractor.

Internal audits will be conducted following any significant procedural changes to the soil preparation processes or other SPF governing documents, to ensure the new methods are implemented and followed appropriately.

The Troy SPF is also required to participate in an annual on-site laboratory audit carried out by the EPA through the QATS contract. Audits consist of an evaluation of facility practices and procedures associated with the preparation of soil samples. A checklist of requirements, as derived from the applicable governing documents and SOPs, is prepared by the auditor prior to the audit, and used during the on-site evaluation. Evaluation of the facility is made by reviewing SPF documentation, observing sample processing, and interviewing personnel.

It is the responsibility of the QATS contractor to prepare an On-site Audit Report following the SPF audit. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each SPF to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an On-Site Audit Trend Analysis Report on an annual basis. This report shall include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this reported is to identify SPF performance problems and isolate the potential causes.

5.9 Procedures for Non-Soil Media

5.9.1 Sample Receipt and Check-In

As noted above, for non-OU3 investigations, if collected field samples are not hand-delivered to the EMSL Mobile Lab, they are sent to the Troy SPF for subsequent shipment to the appropriate analytical laboratory or archive. The sample receipt and check-in procedures for non-soil media are identical to those for soil (see Section 5.1.1). The SPF sample coordinator will review the COC to ensure that the appropriate analytical methods are specified and that the appropriate Analytical Requirements Summary Sheet is attached. The SPF sample coordinator will coordinate with the LC on the appropriate analytical laboratory for each COC.

5.9.2 Sample Custody and Documentation

In general, all samples identified on a COC will be maintained in the same sample shipment. If a subset of the samples on the COC are not to be analyzed (e.g., archive field blanks, paired low volume filters), they will be archived at the analytical laboratory until all samples on the COC are shipped back to the SPF for archiving. The SPF will sign and date the COC, retain a copy for their files.

Prior to shipment, a second SPF staff member will check the container contents to ensure sample labels are correct and that no duplicate or missing labels are present. The COC will also be checked to ensure that the correct analysis was requested, the correct shipping date and air bill number is recorded, and that all samples listed on the COC are included in the shipment.

The reviewer will initial and date the COC forms after review and will record the COC number in the SPF logbook.

Information on the COC number and analytical laboratory where the samples were shipped is managed in Google Docs by the SPF sample coordinator (or their designate).

Upon receipt at the analytical laboratory, the analytical laboratory sample coordinator will scan and email a copy of the final signed COC to the SPF sample coordinator and the appropriate project data manager.

If any discrepancies are found on a COC after shipment to the analytical laboratory, the discrepancy must be documented and communicated as described in the latest revision of the Libby Chain-of-Custody Documentation SOP (ER8-Libby-01).

5.9.3 Final Sample Storage and Archive

After all samples on a COC have been analyzed, the analytical laboratory will package any filter cassettes that were not analyzed and the remaining fractions of filters that were analyzed for shipment to the ESAT archive facility in Troy. (Prepared TEM grids remain in archive at the analytical laboratory.) At the Troy SPF, filter cassettes and remaining filters are bagged together, grouped by COC, and placed into storage at the archive facility.

Section 6 Data Management Procedures and Requirements

This section provides an overview of the data management applications utilized at the Site, summarizes data management procedures and requirements, and provides information on data reporting. Because data management procedures differ for OU3 relative to the other Site OUs, the data management procedures are split into two subsections, one for non-OU3 investigations and one for OU3 investigations.

This section also describes procedures and requirements for data verification, data validation, and data usability assessments that are applicable to all OUs.

6.1 Non-OU3 Investigations

The following subsections describe the field, soil preparation facility, and analytical laboratory data management procedures and requirements for non-OU3 investigations. These subsections also describe the project databases utilized to manage and report Site data. Detailed information regarding data management procedures and requirements for non-OU3 investigations can be found in the *EPA Data Management Plan* for the Libby Asbestos Superfund Site.

6.1.1 Field Data Management

There are five different resources that are utilized in the field to manage site data for most OUs including local field Scribe databases, the Response Manager, Property Operating Tracking System (POTS) database, LibbyGeo, and the Libby2 database, which contains all sample preparation and analytical data from 1999-2009.

6.1.1.1 Local Field Scribe Databases

Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Data for the Site are captured in various Scribe projects. Additional information regarding Scribe and the Libby Scribe Project Databases is discussed in Section 6.1.4.

The field data manager utilizes a "local" field Scribe project database to maintain field sample information. Appendix A of the *EPA Data Management Plan* provides a summary of the Scribe data reporting requirements for field data. The term "local" denotes that the database resides on the server or personal computer of the entity that is responsible for the creating/managing the database. It is the responsibility of the field data manager to ensure that all local field Scribe project databases are backed-up nightly to a local server.

As noted previously (see Section 3.2.13), field sample information from the FSDS is manually entered by a member of the field sample coordination staff using a series of standardized data entry forms (i.e., DE Tool). This tool is a Microsoft Access database that was originally developed by ESAT. The DE Tool is currently maintained by CDM Smith and resides on the local server in the Libby field office. This tool is designed to automatically calculate the total air

sample volume based on the pump start/stop times and flow rates (see Section 3.1.1.5) and is used to prepare an electronic COC. Data in the DE Tool are imported into the local field Scribe project database by the field data manager.

It is the responsibility of the field data manager to "publish" sample and COC information from the local field Scribe database to Scribe.NET when new data are added. It is not until a database has been published via Scribe.NET that it becomes available to external users. In the event that errors are identified after the data are published, it is the responsibility of the field data manager to make any necessary corrections and re-publish the local field Scribe project database to Scribe.NET.

6.1.1.2 Response Manager

Response Manager is a SQL server database tool developed for managing property information for Libby, Montana. This application is used to track property information, including records of property access and remediation status information, owner names and contact information, property-specific communications made at the relevant Information Center (e.g., ERS, U-Dig), and the status of all actions taken in response to these interactions.

Weston is the contractor that is responsible for the development and maintenance of Response Manager. The Response Manager database is maintained on the Weston server, which is regularly backed up. Copies of Response Manager are also kept on the CDM Smith server and the EPA Orator server in Research Triangle Park as an additional back-up and to allow for querying by data users.

Data users must install Response Manager and request an account from the Libby Data Manager, who will coordinate with Weston. Data users can utilize standard forms and queries within Response Manager to input and retrieve data, respectively. Data users may also develop custom queries to extract the desired data. This requires that the data user is proficient in query.

6.1.1.3 LibbyGeo

LibbyGeo is a GIS resource (i.e., a spatial data electronic "warehouse") that contains spatial "layers" for OU boundaries, removal zones, neighborhoods, and GeoUnits. A GeoUnit is a spatial "polygon" on a map that is used to segregate the larger OUs into smaller units. GeoUnits are usually tax parcels, but they may also be other custom spatial polygons that represent non-taxable areas, such as alleys and parks. LibbyGeo stores GIS information for each GeoUnit and property assignments to each GeoUnit. In most cases, one property is associated with one GeoUnit, but in some cases multiple Property IDs can be associated with the same GeoUnit (e.g., house with separate apartment). LibbyGeo is maintained on the EPA Region 8 server. Data users may contact the EPA (John Wieber, Libby GIS Data Coordinator) to request spatial data from LibbyGeo.

6.1.1.4 POTS

POTS is a Libby-specific database used for tracking removal-related property information. This information generally includes: records of communication (internal to the removal contractor and external with property contacts); anticipated and actual volumes of contaminated material,

and other construction material as applicable; phases of the removal process and whether they are completed and/or approved (e.g., removal plan reviewed with resident, removal plan approved by USACE, U-Dig completed); resident relocation and reimbursement information; other removal process checks (e.g., keys returned to resident, plants watered); and any call-back issues and resolutions.

POTS is set up to display (in read-only format) contact, access, and status information from Response Manager, which serves as a quality check on Response Manager data but maintains data integrity within the integrated system. Corrections/edits are made in Response Manager and automatically synchronize with POTS on a routine basis.

Once in full release, CDM Smith and PRI-ER will be responsible for entering GPI and cleanup/restoration information, respectively. CDM Smith is currently tasked to continue development (as needed) and maintain the POTS database for all users, as well as *ad hoc* reporting. The USACE may also have access at some point.

6.1.2 Troy Sample Preparation Facility Data Management

The Troy SPF also utilizes two local SPF Scribe project database to maintain soil sample preparation information, one for samples to be analyzed by PLM and another for those subject to the FBAS. As noted previously (see Section 5.1.7.3), soil preparation information from the log sheets is entered into the local SPF Scribe project database by SPF personnel. Appendix A of the *EPA Data Management Plan* provides a summary of the Scribe data reporting requirements for SPF data. After the data entry is checked against the original forms, it is the responsibility of the SPF manager (or their designate) to publish soil sample preparation information from the local SPF Scribe database to Scribe.NET.

In the event that errors are identified after the data are published, it is the responsibility of the SPF manager to make any necessary corrections and re-publish the local SPF Scribe project database to Scribe.NET. It is also the responsibility of the SPF manager to ensure that the local SPF Scribe project database is backed-up nightly to a local server.

6.1.3 Analytical Laboratory Data Management

As discussed previously (see Section 4.6.2), the analytical laboratories utilize several standardized data reporting tools developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique Libby-specific EDD has been developed for each analytical method and sample media type. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom (see **Appendix B**).

Once the analytical laboratory has populated the EDD with results and they have been verified as complete and accurate, they are both transmitted via email to the ESAT LC and loaded to the FTP site. (Other email recipients may also be specified by the ESAT LC).

The ESAT project database manager utilizes several local analytical Scribe project databases to maintain analytical results information. In general, starting in 2010, there has been one local analytical Scribe project database for each year (e.g., LibbyLab2010.mdb, LibbyLab2011.mdb, etc.) that includes results for all OUs. The EDDs are uploaded directly into the appropriate

analytical Scribe project database according to when the analysis was performed. It is the responsibility of the ESAT project data manager to publish analytical results information from the local analytical Scribe database to Scribe.NET. Appendix A of the *EPA Data Management Plan* provides a summary of the Scribe data reporting requirements for analytical data.

It is the responsibility of the ESAT project data manager to coordinate with the LC and the analytical laboratories to make any necessary corrections and re-publish the local analytical Scribe project database to Scribe.NET. It is also the responsibility of the ESAT project data manager to ensure that the local analytical Scribe project databases are backed-up nightly to a local server.

6.1.4 Libby Project Database

Historically, there was a single SQL server database for the entire Libby project, referred to as the "Libby2 Database", which was used to manage and maintain most[k] sample information, analysis details, and analytical results for all samples collected at the Site. The Libby2 Database was also used to track property status information. As of December 2009, the Libby2 Database is no longer utilized to manage Site data or property status. The Libby2 Database has been decommissioned and is archived on the EPA Region 8 server in Denver, CO.

All data collected at the Site since January 2010 are maintained exclusively in Scribe. As discussed above, data for the Site are captured in various Scribe project databases, including field Scribe projects, SPF Scribe projects, and analytical results Scribe projects.

As noted above, Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Multiple Scribe projects can be stored and shared through Scribe.NET, which is a web-based portal that allows multiple data users controlled access to Scribe projects. Local Scribe projects are "published" to Scribe.NET by the entity responsible for managing the local Scribe project. External data users may "subscribe" to the published Scribe projects via Scribe.NET to access data. Subscription requests are managed by ERT.

All of the field related data contained in the Libby2 Database, including all investigative and H&S programs conducted at the Site from 1999-2009, have been migrated to Scribe. However, the analytical and soil preparation information has not been migrated, and there are currently no plans to do so.

Data users should contact ERT for more information on the available Scribe projects for the Libby Site.

6.1.5 Data Reporting

Data users can access data for the Libby project through Scribe.NET or Libby2 Database. To access data, a data user must first download the Scribe application from the EPA ERT website[l]. The data user must then subscribe to each of the published Scribe projects for the Site using

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[k] Investigation samples from OU3 and OU7 were not maintained in the Libby2 Database.
[l] http://www.ertsupport.org/scribe_home.htm

login and password information that are specific to each individual Scribe project. As noted above, Scribe subscriptions for the Libby project are managed by ERT. Using the Scribe application, a data user may download a copy of any published Scribe project database to their local hard drive. It is the responsibility of the data user to regularly update their local copies of the Libby Scribe projects via Scribe.NET.

The Scribe application provides several standard queries that can be used to summarize and view results within an individual Scribe project. However, these standard Scribe queries cannot be used to summarize results across multiple Scribe projects (e.g., it is not possible to query both the "OU4Field" project and the "LibbyLab2011" project using these standard Scribe queries).

At this time, if data users wish to summarize results across multiple published Scribe projects, there are two potential options. One option is data users may request access to a "combined" project from ERT. This combined project compiles tables from multiple published Scribe projects into a single Scribe project. This allows data users to utilize the standard Scribe queries to summarize and view results.

Alternatively, a second option is data users may download copies of multiple published Scribe project databases for the Site and utilize Microsoft Access to create user-defined queries to extract the desired data across Scribe projects. This requires that the data user is proficient in Microsoft Access and has an intimate knowledge of proper querying methods for asbestos data for the Site.

It is the responsibility of the data users to perform a review of results generated by any data queries and standard reports to ensure that they are accurate, complete, and representative. If issues are identified by the data user, they should be reported to the ESAT project data manager for resolution through a Data Management Request form (see **Appendix E**). It is the responsibility of the ESAT project data manager to notify the appropriate entity (e.g., field, Troy SPF, analytical laboratory) in order to rectify the issue. A follow-up email will be sent to the party reporting the issue to serve as confirmation that a resolution has been reached and any necessary changes have been made.

6.2 OU3 Investigations

Data management procedures differ at OU3 from the other Site OUs because of the unique nature of the interaction between the EPA and W.R Grace for this OU. The following subsections describe the field, soil preparation facility, and analytical data management procedures and requirements for OU3 investigations. These subsections also describe the project database utilized to manage and report OU3 data.

6.2.1 Field Data Management

Remedium contractors perform all investigation-specific field sample collection in accordance with the investigation-specific QAPPs developed by the EPA. As noted previously, CDM Smith is responsible for H&S sampling for workers that drive on Rainy Creek Road and for water sampling in the Kootenai River in support of OU4 response action activities. Field data management procedures for these types of samples follow those described above in Section 6.2. After sample collection, sample details provided on the FSDS and COC forms are manually entered by the field sample coordinator (or their designate) into a field-specific OU3 Microsoft

Access database using electronic data entry forms. The field-specific OU3 database is a simplified version of the master OU3 project database (see Section 6.2.4). The field-specific OU3 database is developed and maintained by the OU3 CDM Smith data manager with input from the field teams. This simplified database includes only the station and sample recording and tracking tables, as well as the FSDS and COC data entry forms. The use of electronic data entry forms ensures the accuracy of data entry and helps maintain data integrity. For example, the OU3 field data entry forms utilize drop-down menus and check boxes whenever possible. These features allow the data entry personnel to select from a set of standard inputs, thereby preventing duplication and transcription errors and limiting the number of available selections (e.g., media types). In addition, entry into a database allows for the incorporation of data entry checks. For example, the database will allow a unique sample number to only be entered once, thus ensuring that duplicate records cannot be created.

At a minimum, the field data manager (i.e., Remedium's field contractor) will complete the entry of FSDS forms and COC information on a weekly basis during the investigation, or more frequently as conditions permit. The field data manager will scan and post copies of all FSDS forms, COC forms, and field log books to the Libby OU3 eRoom on a weekly basis (see **Appendix B**). This eRoom has controlled access (i.e., user name and password are required) to ensure data access is limited to appropriate project-related personnel. File names for scanned FSDS forms, COC forms, and field log books include the sample date in the format YYYYMMDD to facilitate document organization (e.g., FSDS_20110412.pdf). Electronic copies of all digital photographs will also be posted weekly to the Libby OU3 eRoom. File names for digital photographs will include the station identifier, the sample date, and photograph identifier (e.g., ST-1_20110412_12345.tif).

After field data entry is completed, a copy of the field-specific OU3 database will be posted weekly by the field data manager (i.e., Remedium's field contractor) to the Libby OU3 eRoom, or more frequently as conditions permit. The field-specific OU3 database posted to the Libby OU3 eRoom site will include the post date in the file name (e.g., FieldOU3DB_20110516.mdb).

All FSDS and COC data entry is checked against the field documentation by the OU3 database manager (or their designate). If errors are identified, the OU3 database manager will request that appropriate changes are made to the field OU3 project database and/or field documentation by the sample coordination staff and that revised files be posted to the Libby OU3 eRoom (see **Appendix B**).

6.2.2 Troy Sample Preparation Facility Data Management

Historically, all soil-like samples for PLM analysis collected at OU3 were prepared by the CDM Smith Close Support Facility (CSF) in Denver, Colorado. The CSF is no longer processing samples for the Site.

If soil-like samples collected from OU3 require analysis by the Site-specific PLM SOPs, *the investigation- specific QAPPs will provide information on who will perform this preparation and how the resulting preparation data will be managed.*

6.2.3 Analytical Laboratory Data Management

Each of the laboratories performing asbestos analyses for OU3 are required to utilize the appropriate Microsoft Excel EDD spreadsheets for asbestos data recording and electronic submittals (see Section 4.6.2). Electronic copies of all current EDD templates are available in the Libby Lab eRoom (see **Appendix B**).

Once the analytical laboratory has populated the EDD with results, the spreadsheet(s) will be posted to the Libby OU3 eRoom within the appropriate turn-around time. Hardcopies of all analytical laboratory data packages will be scanned and posted to the Libby OU3 eRoom. File names for scanned analytical laboratory data packages will include the laboratory name and the job number to facilitate document organization (e.g., LabX_12345-A.pdf).

6.2.4 Master OU3 Project Database

Unless specified otherwise in the investigation-specific QAPPs, all field and analytical data (including both asbestos and non-asbestos data) for OU3 are managed and maintained in the master OU3 project database. The master OU3 project database is a relational Microsoft Access database developed specifically for OU3. The *Libby OU3 Database User's Guide* provides an overview of the master OU3 project database structure and content. The most recent version of this *User's Guide* is provided on the OU3 website (see **Appendix B**).

Day-to-day operations of the master OU3 project database are under the control of EPA's contractor, CDM Smith. The CDM Smith project data manager is responsible for sample tracking, uploading new field and analytical data, performing error checks, and making any necessary data corrections. To facilitate this process, CDM Smith has developed a series of data entry forms and upload procedures that are specific to the master OU3 project database.

The master OU3 project database is kept on the CDM Smith server in Denver. Incremental backups of the master OU3 project database are performed daily Monday through Friday, and a full backup is performed each Saturday. The full backup tapes are stored off-site for 30 days. After 30 days, the tape is placed back into the tape library to be overwritten by another full backup.

6.2.5 Data Reporting

Analytical results summaries are included in the OU3 investigation-specific QAPPs and Data Summary Reports that are available on the OU3 website (see **Appendix B**). Specialized requests for data summaries may be submitted to the OU3 RPM.

6.3 Data Verification

Data verification includes checking that results have been transferred correctly from the original hand-written, hardcopy field and analytical laboratory documentation to the project database. The goal of data verification is to identify and correct data reporting errors.

For analytical laboratories that utilize the project-specific EDD spreadsheets, data checking of reported analytical results begins with automated QC checks that have been built into the spreadsheets.

In addition to these automated checks, more detailed manual data verification efforts will be performed on 10%-100% of specified data sets. This data verification process utilizes Site-specific SOPs developed to ensure TEM and PLM results and field sample information in the project database are accurate and reliable:

- EPA-LIBBY-09 – *SOP for TEM Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of TEM analyses, based on a review of the laboratory bench sheets, and verification of the transfer of results from the bench sheets into the project database.

- EPA-LIBBY-10 - *SOP for PLM Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of PLM analyses, based on a review of the laboratory bench sheets, and verification of the transfer of results from the bench sheets into the project database.

- EPA-LIBBY-11 - *SOP for FSDS Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of field sample information, based on a review of the FSDS form, and verification of the transfer of results from the FSDS forms into the project database. An FSDS review is performed on all samples selected for TEM or PLM data verification.

These regular data verification reviews will ensure that any data reporting issues are quickly identified and rectified to limit any impact on overall data quality. If issues are identified during the data verification, the frequency of these checks may be increased as appropriate.

Data verification is required for 100% of all TEM and PLM results that are reported to property owners. *The investigation-specific QAPPs will specify any additional data verification requirements.*

Data verification will be performed by appropriate technical support staff that is familiar with project-specific data reporting, analytical methods, and investigation requirements. The data verifier will prepare a data verification report (template reports are included in the SOPs) to summarize any issues identified and necessary corrections. A copy of this report will be provided to the appropriate project data manager, LC, and the EPA RPM or MDEQ project manager. For non-OU3 data reviews, the verification findings are posted to the eRoom and to the ESAT project data manager for resolution. A follow-up email will be sent to the party reporting the issue to serve as confirmation that a resolution has been reached.

It is the responsibility of the project data manager to coordinate with the FTL and/or LC to resolve any project database corrections and address any recommended field or laboratory procedural changes from the data verifier. The project data manager is also responsible for electronically tracking in the project database which data have been verified and who performed the verification.

6.4 Data Validation

Unlike data verification, the goal of data validation (in addition to identifying data reporting errors) is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to any potential data quality issues. Data validation will be performed by the QATS

contractor, with support from technical support staff who are familiar with project-specific data reporting, analytical methods, and investigation requirements.

Data validation for PCM, PLM, and TEM should be performed in basic accordance with the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011), and should include an assessment of the following:

- Internal laboratory QC analysis results (including all soil preparation, PCM, TEM, and PLM laboratory QC analysis results)
- Inter-laboratory analysis results
- Instrument checks and calibration results
- Data verification results (i.e., in the event that the verification effort identifies a larger data quality issue)

A comprehensive data validation effort should be completed annually, with the results reported in data deliverable–specific (i.e. laboratory jobs) validation summary reports. These validation summary reports will detail the validation procedures performed and provide a narrative on the quality assessment for each type of analysis (PCM, PLM, TEM), including the data qualifiers assigned, and the reason(s) for these qualifiers.

The QATS contractor will also prepare an annual *Quality Assurance and Quality Control Summary Report for the Libby Asbestos Superfund Site* (CDM Smith 2011), which, an addition to a summary of other quality control elements (i.e. on-site audits, field QC samples, and Inter-lab studies), will provide a summary of the data validation effort. This summary report will also include a summary of any data qualifiers that are to be added to the project database to denote when results do not meet NFG guidelines and/or project-specific acceptance criteria. This report will also include recommendations for Site QA/QC program changes to address any data quality issues. As appropriate, this QARD will be revised to incorporate these recommendations.

It is the responsibility of the project data manager to ensure that the appropriate data qualifiers and reason codes recommended by the data validator are added to the project database, and to electronically track in the project database which data have been validated, who performed the validation, and when.

In addition to performing data validation efforts, it is the responsibility of the QATS contractor (or their designate) to perform a regular evaluation of all field blanks and SPF preparation blanks, to ensure that any potential contamination issues are quickly identified and resolved. If any blank results are outside the acceptable limits (see Section 3.1 for field QC and Section 5.2 for SPF preparation QC), the QATS contractor should immediately contact the appropriate field QAM or SPF QAM to ensure that corrective actions are made.

6.5 Data Management Audits

As noted in the *Data Management Plan*, the EPA plans to conduct regular audits of data management procedures at the Site. These audits will ensure that data management procedures are adequate to meet data quality needs for the Libby project.

At this time, the specific details on how these audits will be performed, the types of information that will be assessed, and potential corrective actions necessary to address identified deficiencies are not yet available. This QARD will be updated to provide details on the data management auditing procedures in the future, as appropriate.

6.6 Data Usability Assessment

It is the responsibility of data users to perform a data usability assessment to ensure that DQOs have been met, and reported investigation results are adequate and appropriate for their intended use. This data usability assessment should utilize results of the data verification and data validation efforts to provide information on overall data quality specific to each investigation.

The data usability assessment should evaluate results with regard to several data usability indicators. **Table 6-1** summarizes several indicators of data usability and presents general evaluation methods for each indicator. Depending upon the nature of the investigation, other evaluation methods may also be appropriate. The data usability assessment results and conclusions should be included in any investigation-specific data summary reports.

Section 7 References

CDM Smith (formerly CDM). 2011. Quality Assurance and Quality Control Summary Report (1999-2009) for the Libby Asbestos Superfund Site. Draft – May 24, 2011.

EPA (U.S. Environmental Protection Agency). 2008a. Technical Memorandum 8: Procedure for Combining Mass Fraction Estimates of Libby Amphibole for the Coarse and Fine Fractions of Soil and Soil-Like Samples at the Libby Asbestos Superfund Site. February 21, 2008.

_____. 2008b. Performance Evaluation of Laboratory Methods for the Analysis of Asbestos in Soil at the Libby, Montana Superfund Site. Produced by Syracuse Research Corporation for EPA, Region 8. Draft – October 7, 2008.

_____. 2008c. Characteristic EDS Spectra for Libby-Type Amphiboles. Produced by Syracuse Research Corporation for EPA, Region 8. Final – March 18, 2008.

_____. 2011. National Functional Guidelines for Asbestos Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. Draft – August 2011.

_____. 1994. NIOSH Method 7400, Asbestos and Other Fibers by PCM, – August 15, 1994.

Nelson, W. 1982. *Applied Life Data Analysis.* John Wiley & Sons, New York. pp 438-446.

NIST (National Institute of Standards and Technology). 1994. Airborne Asbestos Method: Standard Test method for Verified Analysis of Asbestos by Transmission Electron Microscopy – Version 2.0. NIST, Washington DC. NISTIR 5351. March 1994.

_____. 2006a. NIST Handbook 150-3: National Voluntary Laboratory Accreditation Program – Bulk Asbestos Analysis. 2006 Edition.
http://ts.nist.gov/Standards/Accreditation/upload/NIST-HB-150-3-2006.pdf

_____. 2006b. NIST Handbook 150-13: National Voluntary Laboratory Accreditation Program – Airborne Asbestos Analysis. 2006 Edition.
http://ts.nist.gov/Standards/Accreditation/upload/NIST-HB-150-13-2006.pdf

APPENDIX A

MAPS OF OU BOUNDARIES

3019-03312014-1

Libby Asbestos Superfund Site
Operable Unit 1

OU 1 - Former Export Plant

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010);
Imagery - 1-meter USDA NAIP (2009).

0 125 250 Feet

0 25 50 Meters

N

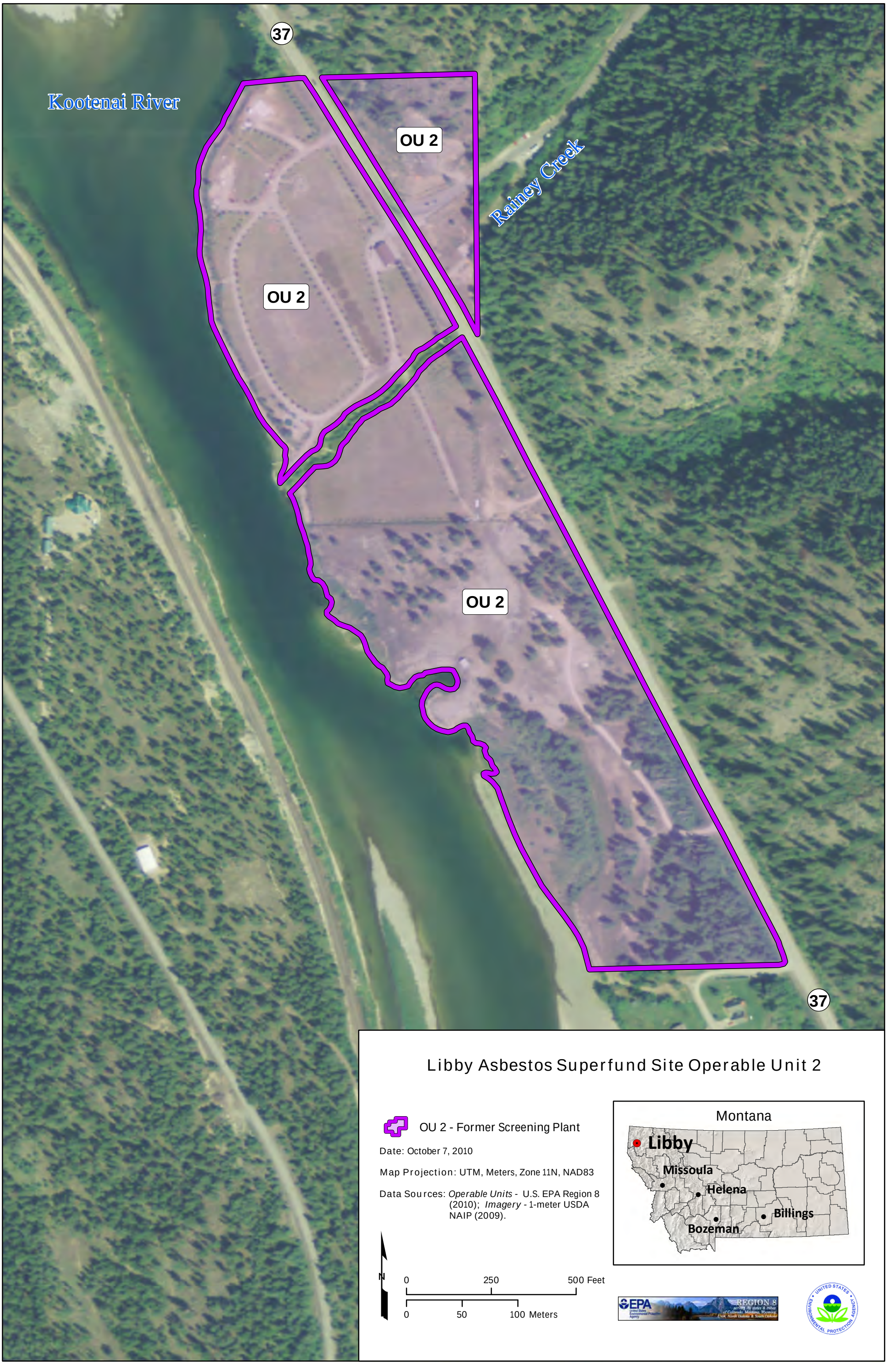
Kootenai River

37

OU 1

OU 1

3019-03312014-1



Libby Asbestos Superfund Site Operable Unit 2

OU 2 - Former Screening Plant

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010); *Imagery* - 1-meter USDA NAIP (2009).

N

0 250 500 Feet

0 50 100 Meters

Montana

Libby
Missoula
Helena
Billings
Bozeman

EPA REGION 8 serving the states & tribes of Colorado, Montana, Wyoming, Utah, North Dakota & South Dakota

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

3019-03312014-1

Libby Asbestos Superfund Site Operable Unit 3 (Study Area)

OU 3 (Study Area) - Mine & Kootenai River

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010);
Imagery - 1-meter USDA NAIP (2009).

0 1 2 Miles

0 1 2 Kilometers

N

OU 3
2
Troy
Kootenai River
OU 3
2
Quartz Creek
Cedar Creek
Pipe Creek Rd
Kootenai River Rd
37
Kootenai River
OU 3
2
Purcell Creek
Flower Creek
Libby
Rainey Creek
OU 3
Lake Koocanusa
37
Kootenai River
2

3019-03312014-1

Libby Asbestos Superfund Site Operable Unit 4

OU 4 - Libby

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010); *Imagery* - 1-meter USDA NAIP (2009).

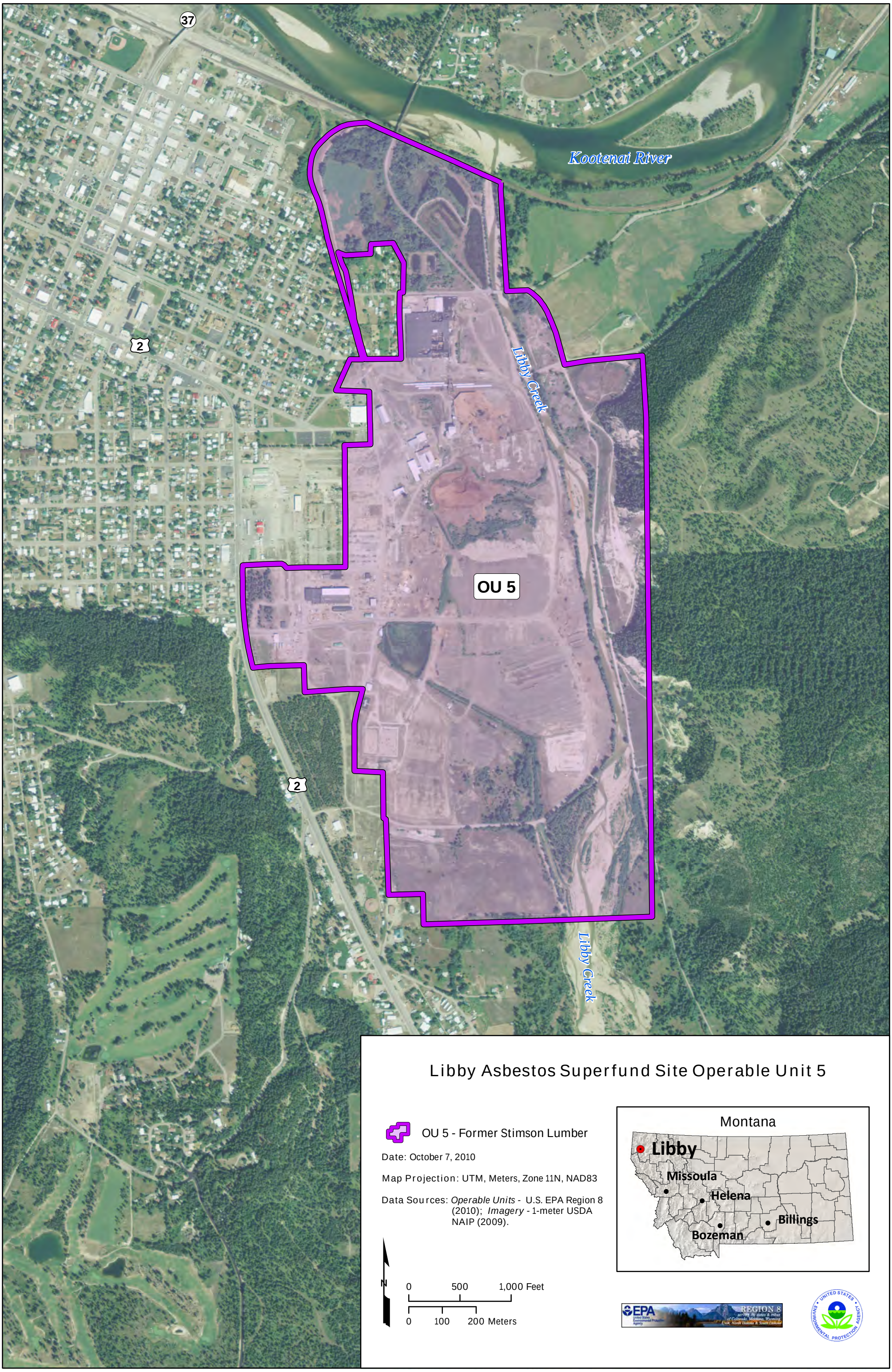
0 1 2 Miles

0 1 2 Kilometers

N

EPA REGION 8

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



Libby Asbestos Superfund Site Operable Unit 5

OU 5 - Former Stimson Lumber

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010); *Imagery* - 1-meter USDA NAIP (2009).

N

0 500 1,000 Feet

0 100 200 Meters

Montana

EPA REGION 8

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

3019-03312014-1

Libby Asbestos Superfund Site
Operable Unit 6

OU 6 - BNSF Rail Corridor

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010);
Imagery - 1-meter USDA NAIP (2009).

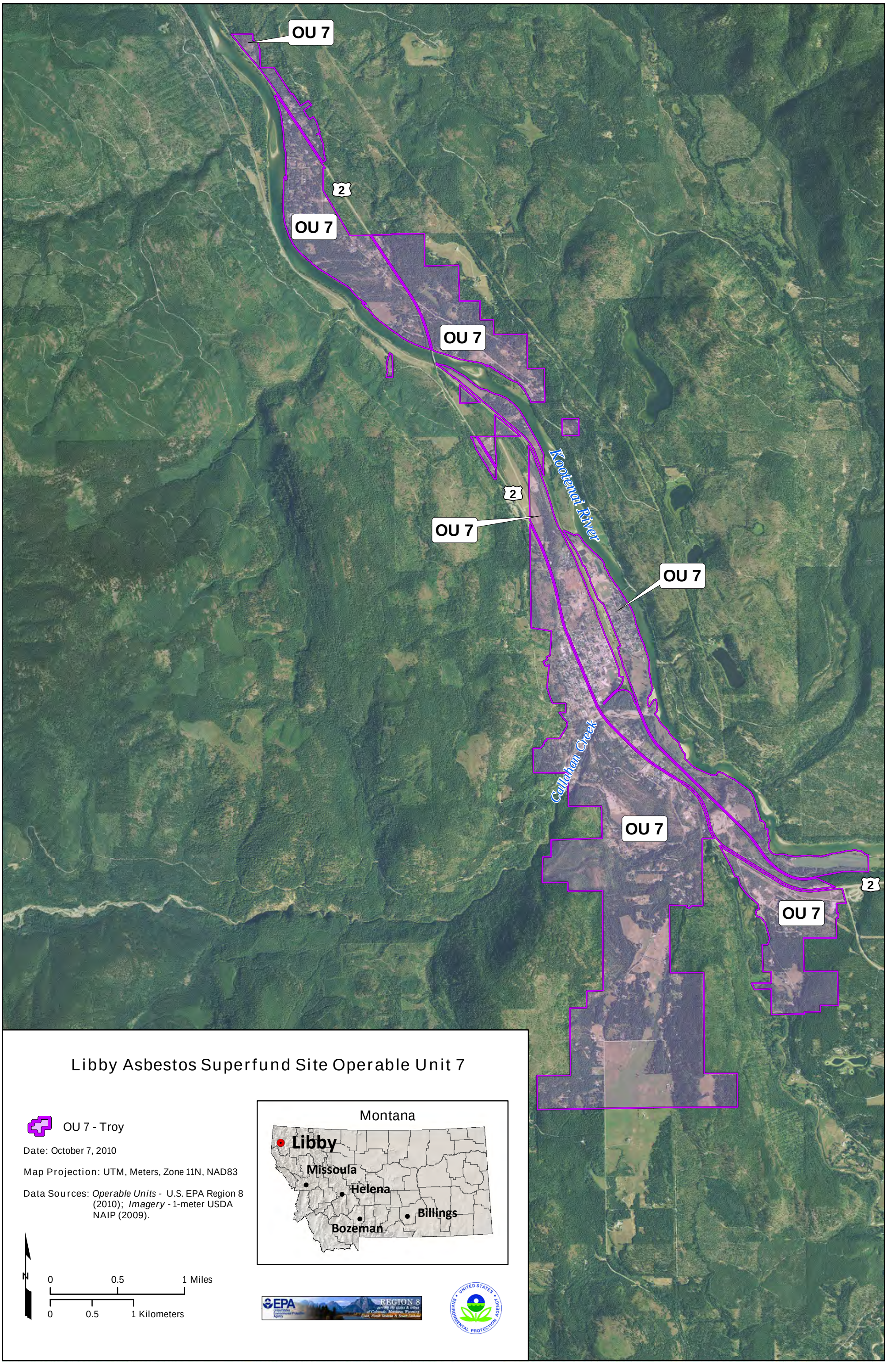
0 1 2 Miles

0 1 2 Kilometers

N

Montana

OU 6
2
Troy
Kootenai River
Quartz Creek
Pipe Creek Rd
Cedar Creek
Kootenai River Rd
Rainy Creek
37
Purmenter Creek
Flower Creek
Libby
Big Cherry Creek
Libby Creek
Fisher River



Libby Asbestos Superfund Site Operable Unit 7

OU 7 - Troy

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010); *Imagery* - 1-meter USDA NAIP (2009).

N

0 0.5 1 Miles

0 0.5 1 Kilometers

EPA REGION 8 serving the states & tribes of Colorado, Montana, Wyoming, Utah, North Dakota & South Dakota

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

3019-03312014-1

Libby Asbestos Superfund Site
Operable Unit 8

OU 8 - State Highway Corridors

Date: October 7, 2010

Map Projection: UTM, Meters, Zone 11N, NAD83

Data Sources: *Operable Units* - U.S. EPA Region 8 (2010);
Imagery - 1-meter USDA NAIP (2009).

N

0 1 2 Miles

0 1 2 Kilometers

Montana

EPA REGION 8 serving the states of Colorado, Montana, Wyoming, Utah, North Dakota & South Dakota

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

APPENDIX B

ELECTRONIC REPOSTORIES UTILIZED TO MANAGE/ORGANIZE GOVERNING SITE DOCUMENTS

Appendix B - Electronic Repositories Utilized to Manage/Organize Governing Site Documents

Electronic Repository	Available Information	Access	Maintained by
Site-wide Repositories			
Libby Field eRoom	• **Final Site-wide QARD** • Final Investigation-specific QAPPs and associated ROMs • Current sampling methods and site-specific SOPs • Current HASPs • Current EPA Data Management Plan • Current Troy SPF Sample Preparation Work Plan	https://team.cdm.com/eRoom/R8-RAC/Libby (Libby project team access only; individual user name and password are required)	CDM Smith
Libby Lab eRoom	• Current analytical methods and site-specific SOPs • Laboratory ROMs • Investigation-specific Analytical Requirements Summary Sheets • Laboratory EDD templates • Libby Laboratory Team call notes	https://team.cdm.com/eRoom/mt/LibbyLab (Libby laboratory team access only; individual user name and password are required)	CDM Smith
EPA Region 8 Libby Website	• Final Investigation-specific QAPPs and associated ROMs • Final Data Summary Reports • Final Risk Assessment Reports • Final Remedial Investigation Reports	http://www.epa.gov/libby/ (public access)	EPA
OU3-specific Repositories			
OU3 Website	• Final Investigation-specific QAPPs and associated ROMs • Current sampling and analysis methods and OU3-specific SOPs • Final Data and Field Summary Reports • Final Risk Assessment Reports • Draft documents requiring team review • Copy of Master OU3 Project Database	http://cbec.srcinc.com/libby/ (OU3-specific user name and password are required)	SRC, Inc.
OU3 eRoom	Field • Scanned FSDS forms, field logbooks, COCs • Electronic field data (e.g., temperature monitoring data) • Weekly Field OU3 Project Databases	https://team.cdm.com/eRoom/mt/LibbyOU3/ (OU3 project team access only; individual user name and password are required)	CDM Smith

Electronic Repository	Available Information	Access	Maintained by
	Laboratory • Investigation-specific Analytical Requirements Summary Sheets • Current OU3-specific laboratory EDD templates • Analysis results EDDs • Scanned laboratory job reports		
OU7-specific Repositories			
OU7 SharePoint Portal	• Copy of TOAD • Copy of field Scribe project database • Scanned field documentation	https://home.ttemi.com/sites/troytape/default.aspx (Tetra Tech access only; individual user name and password are required) https://partners.ttemi.com/sites/Troy/default.aspx (individual user name and password are required)	Tetra Tech

APPENDIX C

ANALYTICAL REQUIREMENTS SUMMARY SHEET TEMPLATE

Requirements Summary: # XXXXX-mmyy
Requirements Revision #: 0
Effective Date: mm/dd/yyy

SAP REQUIREMENTS SUMMARY #XXXXX-mmyy
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

SAP Title: _____

SAP Date (Revision): _____

EPA Technical Advisor: _____
(contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: _____
_____
_____
_____

Sample ID Prefix: XX-

TEM/PCM Preparation and Analytical Requirements:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep?		Filter Archive?	Method	Counting/ Recording Rules	Analytical Sensitivity/ Stopping Rules	
			With Ashing	Without Ashing					

Soil Preparation and Analysis Requirements:

Preparation Method	Analysis Method	Applicable Laboratory Modifications (current version of)

Requirements Summary: # XXXXX-mmyy
Requirements Revision #: 0
Effective Date: mm/dd/yyy

Laboratory Quality Control Sample Frequencies:

TEM: Lab Blank – 4%
Recount Same – 1% (i)
Recount Different – 1.5% (i)
Verified Analysis – 1% (i)
Repreparation – 1% (i)
Interlab – 1% (i)

PCM: Blind Recounts – 10% (ii)

PLM: Lab Duplicate (self check) – 2% (iii)
Lab Duplicate (cross check) – 8% (iii)

(i) See LB-000029B for selection procedure and QC acceptance criteria
(ii) See NIOSH 7400 for QC acceptance criteria
(iii) See SRC-LIBBY-03 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description

Analytical Laboratory Review Sign-off:

☐ EMSL – Libby [sign & date: _____]
☐ EMSL – Cinnaminson [sign & date: _____]
☐ EMSL – Beltsville [sign & date: _____]
☐ EMSL – Denver [sign & date: _____]
☐ ESAT [sign & date: _____]
☐ Hygeia [sign & date: _____]
☐ RESI [sign & date: _____]

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified SAP.]

APPENDIX D

LIBBY RECORD OF MODIFICATION FORM TEMPLATES

MOD No.: SPF-_____

Request for Modification
To
Soil Sample Preparation Activities

Instructions to Requester: E-mail form to contacts at bottom of form for review and approval.

File approved copy at the Sample Preparation Facility (SPF).

Requester:_____ Title: _____

Company: _____ Date: _____

Effective Date: _____

Description of Modification:

_____

_____

Reason for Modification:

_____

_____

Potential Implications of this Modification:

_____

_____

Duration of Modification (circle one):

Temporary Date(s): _____
Preparation Batch ID:_____

- Temporary Modification Forms – Attach legible copies of approved form with all associated chain-of-custody forms. Also, maintain legible copies of approved form in a binder that can be accessed by SPF personnel.

Permanent (complete Proposed Modification to Method)

- Permanent Modification Forms – Maintain legible copies of approved form in a binder that can be accessed by CSF personnel.

Proposed Modification to Method (attach additional sheets if necessary; state section and page numbers of Method when applicable):

_____

_____

_____

_____

Technical Review: _____ Date: _____
(SPF Manager or designate)

Approved By:_____ Title: _____ Date: _____
(USEPA: Project Chemist or designate)

Request for Modification
to
Laboratory Activities
LB-0000XX

Instructions to Requester: E-mail form to contacts at bottom of form for review and approval.

All Labs Applicable Forms – copies to: EPA LC, QATS contractor, All Project Labs

Individual Labs Applicable Forms – copies to: EPA LC, QATS contractor, Initiating Lab

Method (circle all applicable):

TEM-AHERA	TEM-ISO 10312	PCM-NIOSH 7400
EPA/600/R-93/116	ASTM 5755	TEM 100.2	SRC-LIBBY-03
SRC-LIBBY-01	NIOSH 9002	Other:_____	

Requester:_____ Title: _____

Company: _____ Date: _____

Original Requester: _____ Original Request Date: _____

[only applicable if modification is a revision of an earlier modification]

Description of Modification:

_____

Reason for Modification:

_____

Potential Implications of this Modification:

_____

Laboratory Applicability (circle one): **All** **Individual(s)** _____

This laboratory modification is (circle one): **NEW** **APPENDS to** _____ **SUPERCEDES** _____

Duration of Modification (circle one):

Temporary Date(s): _____

Analytical Batch ID: _____

Temporary Modification Forms – Attach legible copies of approved form with all associated raw data packages

Permanent (Complete Proposed Modification Section) Effective Date: _____

Permanent Modification Forms – Maintain legible copies of approved form in a binder that can be accessed by analysts.

Proposed Modification to Method (attach additional sheets if necessary; state section and page numbers of method when applicable):

_____

REFERENCES

Data Quality Indicator (circle one) – Please reference definitions below for direction on selecting data quality indicators:

Not Applicable **Reject** **Low Bias** **Estimate** **High Bias** **No Bias**

DATA QUALITY INDICATOR DEFINITIONS:

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely affect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

Technical Review: _____ Date: _____
(Laboratory Manager or designate)

Project Review and Approval: _____ Date: _____
(USEPA: Project Manager or designate)

Approved By: _____ Date: _____
(USEPA: Technical Assistance Unit Chief or designate)

Record of Modification to Documents Governing Field Activities Libby Asbestos Project

Form No. LFO-000xxx

Instructions to Requester: Email draft modification form to the contacts at bottom of form for review and approval. File approved copy with the CDM Quality Assurance Coordinator (QAC) at the Libby Field Office (LFO). The QAC will distribute approved copies and maintain the originals at the LFO.

Requester: _____ Title: _____

Company: _____ Date: _____

Governing document (title and approved date) or SOP (title and SOP number):_____

_____

_____

Field logbook and page number where modification is documented (or attach associated correspondence):

_____

Description of modification (attach additional sheets if necessary; include revised text for all document or SOP sections that are affected by the modification):_____

_____

_____

Implication(s) of modification (if applicable, attach a list of affected property addresses or sample IDs):

_____

_____

_____

Duration of modification (cicle one):

Temporary Date(s):_____

Permanent Effective Date:_____

Data Quality Indicator (indicate one; reference the definitions below for direction on selecting data quality indicators):

❑ Not Applicable	❑ Low Bias	❑ High Bias
❑ Reject	❑ Estimate	❑ No Bias

CDM Technical Review and Approval: _____ Date:_____
(CDM Project Manager or designate)

EPA Review and Approval: _____ Date:_____
(USEPA RPM or designate)

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely effect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

APPENDIX E

ESAT DATA MANAGEMENT REQUEST FORM TEMPLATE

TechLaw Consulting Services

ESAT Region 8
Data Management Request Form

Today's Date:

Name: Phone #:

Organization: Email:

Tool/Database:

Request Category: ☉ Issue ○ Tool ○ Task

Type of Request: Data Fix Attachments Included: None

Attachments:

Request:

Priority: ○ Low ○ Medium ○ High

Date Needed By:

Email:

- ☐ Melissa Bryant
- ☐ Frank McGuire
- ☐ Randy Dorian
- ☐ Diane Rode
- ☐ Erin Formanek
- ☐ Joe Shaefer
- ☐ Janelle Lohman
- ☑ Jim Slavens
- ☐ Other (List)
- ☐ Mark McDaniel
- ☐ Dania Zinner

Figures

Carolyn Rutland
Project Manager
MDEQ

Rebecca Thomas
Project Team Leader
EPA, Region 8

Patti Tyler
Human Subjects Research Officer
EPA, Region 8

Linda Himmelbauer
Quality Assurance Manager
EPA, Region 8

Mary Darling
Program Manager
USACE

Onsite USACE Staff:
Jeremy Ayala, *Project Engineer*
Jeff Hubbard, *Alternate Project Engineer*
Mark Buss, *Onsite Quality Assurance Manager*
Brian Broekemeier, *Construction Control Representative*

David Ray
Quality Assurance Manager
USACE

Elizabeth Fagan, *Remedial Project Manager*
Mike Cirian, *Onsite Remedial Project Manager and Field Team Leader*
EPA, Region 8

Jeff Mosal
Libby Data Manager
EPA, Region 8

Don Goodrich
ESAT Laboratory Contract Manager
EPA, Region 8

Dania Zinner
QATS Libby Task Manage / RPM
EPA, Region 8

Joseph Schaefer
ERT Data Mgmt Contract Manager
EPA, Region 8

Mark McDaniel
ESAT Region 8 Team Manager
TechLaw, Inc.

Nikki MacDonald
ESAT QA Manager
TechLaw, Inc.

Darwin Nelson
Federal Services Group President
CDM Smith

Thomas Cook
Site/USACE Project Manager
CDM Smith

Jo Nell Mullins
Quality Assurance Director
CDM Smith

Janelle Lohman
ESAT Scribe Data Manager
TechLaw, Inc.

Talena Oliver
ESAT PLM Laboratory Manager
TechLaw, Inc.

Douglas Kent
ESAT TEM Laboratory Manager
TechLaw, Inc.

Michael Lenkauskas
Consulant
CB&I Federal Services

CDM Smith Management Staff:
Scott Felton, *Assistant Site Manager*
Damon Repine, *Construction Manager/Field Team Leader*
Tracy Dodge, *Sample Coordinator*
Scott Miller, *Data Manager*
Nic Pisciotta, *H&S Manager*

Terry Crowell
Quality Assurance Manager
CDM Smith

Andrea Wandler
Project Sample Coordinator
TechLaw, Inc.

Brad Morgan
Response Manager Administrator
Weston Solutions, Inc.

Analytical Laboratory Management Staff:
Laboratory Manager
Quality Assurance Manager
Sample Coordinator
Senior Analyst(s)

Troy Soil Preparation Facility Management Staff:
Laboratory Manager
Quality Assurance Manager
Sample Coordinator

Figure 2-1. Organizational Chart for Response Actions at the Libby Asbestos Superfund Site

EPA Region 8 Staff
USACE Staff
MDEQ Staff
CDM Smith Staff
TechLaw Staff
TechLaw Subcontractors
CB&I Staff
Lines of authority
Lines of communication

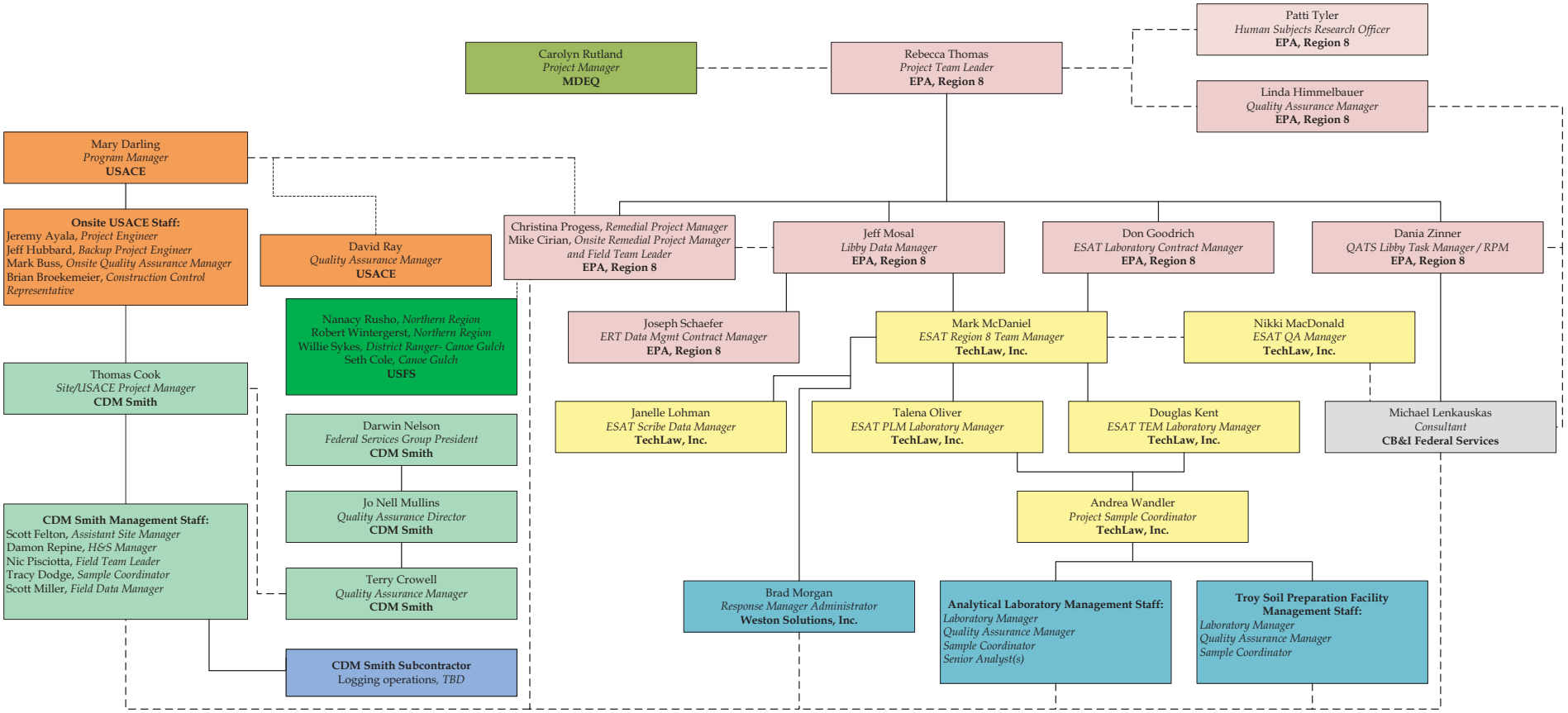


Figure 2-2. Organizational Chart for Commercial Logging ABS

Tables

Table 3-1 Field QC Samples for Each Medium

Type of QC Sample	Minimum Collection Frequency	Acceptance Criteria	Corrective Action
Medium: Air			
Lot Blanks	1 per 500 field cassettes	No asbestos observed	Reject entire batch of cassettes
Field Blanks	1 per field team per day; 1 per week is analyzed	No asbestos observed	Analyze all other field blanks for the same team in the same week; field team/laboratory staff re-training (as appropriate); assign an "FB" data qualifier to associated field samples
Co-located Samples	5% (1 per 20 field samples) or one per sampling event (whichever is higher)	Not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different
Drying Blanks	1 per COC (as needed)	No asbestos observed	Laboratory staff re-training (as appropriate); reassess drying method if 2 consecutive drying blanks do not meet acceptance criteria
Medium: Soil			
Field Duplicates	5% (1 per 20 field samples)	PLM: reported bin is within ±1 bin of the parent field sample TEM: not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different
Medium: Water			
Field Blanks	1 per field team per day; 1 per week is analyzed	No asbestos observed	Field team/laboratory staff re-training (as appropriate); assign an "FB" data qualifier to associated field samples
Field Duplicates	5% (1 per 20 field samples) or one per sampling event (whichever is higher)	Not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different
Equipment Rinsate Blanks	1 per field team per day (if reusable sampling equipment is utilized)	No asbestos observed	Field team staff re-training (as appropriate); assign an "EB" data qualifier to associated field samples
Medium: Bulk Material			
No field QC samples are required			
Medium: Duff Material			
Field Blanks	Not required; *investigation-specific SAPs will specify frequency*	no asbestos observed	Field team/laboratory staff re-training (as appropriate); assign an "FB" data qualifier to associated field samples
Field Duplicates	5% (1 per 20 field samples)	not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different
Medium: Tree Bark			
Field Blanks	Not required; *investigation-specific SAPs will specify frequency*	no asbestos observed	Field team/laboratory staff re-training (as appropriate); assign an "FB" data qualifier to associated field samples
Equipment Rinsate Blanks	1 per field team per day (if reusable sampling equipment is utilized)	no asbestos observed	Field team staff re-training (as appropriate); assign an "EB" data qualifier to associated field samples
Field Duplicates	5% (1 per 20 field samples)	Not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different
Medium: Sediment			
Field Duplicates	5% (1 per 20 field samples)	PLM: reported bin is within ±1 bin of the parent field sample TEM: not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different
Medium: Tissue			
Field Blanks	Refer to the investigation-specific QAPP	No asbestos observed	Refer to the investigation-specific QAPP
Equipment Rinsate Blanks	1 per equipment decontamination effort (if reusable sampling equipment is utilized)	No asbestos observed	Field team staff re-training (as appropriate); assign an "EB" data qualifier to associated field samples
Field Duplicates	Collected for each animal	Not statistically different based on Poisson ratio test at 90% confidence interval	Alert data users to variability if more than 20% of co-located samples are statistically different

COC - chain of custody
PLM - polarized light microscopy
QC - quality control
SAP - sampling and analysis plan
TEM - transmission electron microscopy

Table 4-1 Site-Specific Requirements for Analytical Laboratory QC Samples

Type of QC Sample	Collection Frequency	Acceptance Criteria	Corrective Action
PCM			
No additional requirements beyond those specified in NIOSH 7400.			
TEM			
Laboratory Blanks	4% (4 per 100 analyses)	No asbestos observed	Laboratory staff re-training (as appropriate); reassess filter preparation methods
Drying Blanks	1 per COC (as needed)	No asbestos observed	Laboratory staff re-training (as appropriate); reassess drying method if 2 consecutive drying blanks do not meet acceptance criteria
Recounts	Recount Same: 1% Recount Different: 2.5% Verified Analysis: 1% Inter-laboratory: 1% (1 recount per 20 analyses)	See current revison of LB-000029 for grid opening- and structure-specific acceptance criteria	Perform a verified analysis, senior laboratory analyst will use these results of the validated analysis to determine the basis of the discordance and appropriate corrective action (e.g., re-training in counting rules, quantification of size, identification of types, etc.)
Repreparation	1% (1 per 100 analyses)	Not statistically different based on Poisson ratio test at 90% confidence interval	Analyst re-training in sample and filter preparation, counting rules, quantification of size, identification of types, etc.
LA-specific Performance Evaluation Standards	LA-specific standards are not available at this time.		
PLM, NIOSH 9002			
No additional requirements beyond those specified in NIOSH 9002.			
PLM-VE, Libby-specific Method			
Laboratory Duplicates	Self-check: 2% (1 per 50 analyses) Cross-check: 4% (2 per 25 analyses) Cross-check Re-prep : 4% (2 per 25 analyses)	Reported PLM bin is within ±1 bin of the parent field sample	Laboratory staff re-training and re-analysis or repreparation of samples (as appropriate)
Inter-laboratory	1% (1 per 100 analyses)	See current revsion of LB-000073 for program-wide acceptance criteria	Re-analysis or repreparation (as appropriate), collaboration between and amongst laboratories to address between laboratory differences, and analyst re-training
LA-specific Performance Evaluation Standards	1 per month (when soil processing is occurring)	Correct PLM bin is reported (as determined based on the nominal level)	Laboratory staff re-training and re-analysis or repreparation of samples (as appropriate)

COC - chain of custody
LA - Libby amphibole
NIOSH - National Institute of Occupational Safety and Health
PCM - phase contrast microscopy
PLM - polarized light microscopy
QC - quality control
SAP - sampling and analysis plan
TEM - transmission electron microscopy

Table 5-1 Soil Preparation QC Samples

Type of QC Sample	Collection Frequency	Acceptance Criteria	Corrective Action
Soil Preparation for PLM (SOP ISSI-LIBBY-01)			
Sand Blanks	40 per bag	All 40 sand blanks are PLM-VE Bin A (non-detect)	Reject entire bag of sand
Drying Blanks	1 per drying batch	PLM-VE Bin A (non-detect)	Clean drying oven; assign an "DB" data qualifier to associated field samples; reassess drying method if subsequent drying blank does not meet acceptance criteria following oven cleaning
Grinding Blanks	1 per grinding batch per grinder per day	PLM-VE Bin A (non-detect)	Clean grinder; assign an "GB" data qualifier to associated field samples; reassess grinding method if subsequent grinding blank does not meet acceptance criteria following grinder cleaning
Preparation Duplicates	5% (1 per 20 field samples)	Reported PLM bin is within ±1 bin of the parent field sample	Alert data users to variability if more than 10% of co-located samples are statistically different
FBAS Preparation for TEM (SOP ESAT-LIBBY-01)			
Sieve Blanks	5% (1 per 20 field samples)	Non-detect	Results of sieve blanks will be tracked to monitor contamination as it related to the entire process.
Filter Lot Blank	1 per each lot of 500 filter cassettes, to be analyzed prior to use.	Non-detect	The filter lot is rejected if one asbestos fiber is counted in the analysis
Sieve Duplicate	5% (1 per 20 field samples)	None	Results of sieve duplicates will be tracked to monitor precision of the entire process.
Preparation Blank	1 per day for each day the FBAS is operated or 1 per batch, whichever is more frequent	Non-detect	Immediate investigation into the source of contamination and steps taken to eliminate the source prior to resuming FBAS activities
FBAS Replicate	Upon request or as specified in the applicable SAP and/or QAPP	None	Results of FBAS replicates will be tracked to monitor precision of the entire process.

PLM-VE - polarized light microscopy with visual area estimation
QC - quality control

Table 6-1 General Evaluation Methods for Assessing Data Usability

Data Usability Indicator	General Evaluation Method
Precision	Sampling – Review* results for co-located samples and field duplicates to provide information on variability arising from medium spatial heterogeneity and sampling and analysis methods. Soil Preparation – Review* results for preparation duplicates to provide information on variability arising from sample preparation and analysis methods. Analysis – Review* results for PLM laboratory duplicates, TEM recounts, and TEM repreparations to provide information on variability arising from analysis methods. Review* results for inter-laboratory analyses to provide information on variability and potential bias between laboratories.
Accuracy/Bias	TEM – Calculate the background filter loading rate and use results to assign detect/non-detect in basic accordance with ASTM 6620-00. For air samples, determine the frequency of indirect preparation. PLM – Review* results for LA-specific performance evaluation standards to provide information on direction/magnitude of potential bias. Review* results for blanks to provide information on potential contamination.
Representativeness	Review* relevant field audit report findings and any field/laboratory ROMs for potential data quality issues.
Comparability	Compare the sample collection SOPs, preparation techniques, and analysis methods to previous investigations.
Completeness	Determine the percent of samples that were able to be successfully collected and analyzed in accordance with the investigation-specific SAP requirements (e.g., 99 of 100 samples, 99%).
Sensitivity	TEM – Determine the fraction of all analyses that stopped based on the area examined stopping rule (i.e., did not achieve the target sensitivity).
** This information should be summarized in the data validation technical memoranda prepared quarterly by the QATS contractor (see Section 6.4).*	

ASTM = American Society of Testing and Materials
LA = Libby amphibole
PLM = polarized light microscopy
QATS = Quality Assurance Technical Support
ROM = record of modification
SAP = sampling and analysis plan
SOP = standard operating procedure
TEM = transmission electron microscopy